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THE DIVISION OF SURGERY

OF

THE MEDICAL SCHOOL OF HARVARD UNIVERSITY

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REPORT OF RESEARCH WORK, 1903-1904

MARCH, 1904

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of
The Medical School of Harvard University.

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THE DIVISION OF SURGERY

OF

The Medical School of Harvard University

REPORT OF RESEARCH WORK, 1903-1904

MARCH, 1904

INTRODUCTION.

ON Feb. 1, 1903, the following letter was sent out by the Committee on Surgical Research of the Division of Surgery of the Harvard Medical School to the surgeons of the Massachusetts General Hospital, the Boston City Hospital and the Children's Hospital:

DEPARTMENT OF SURGERY,
HARVARD MEDICAL SCHOOL, Feb. 1, 1903.

Dear Sir: The recent work by Dr. Crile on surgical shock and the representation by Dr. Cushing of the importance of blood-pressure observations in surgical diagnosis and treatment have produced a widespread interest in these methods of investigation of surgical problems, and one which the Surgical Department of the Harvard Medical School desires to encourage in every way within its power.

To this end the Committee on Surgical Research has organized an investigation, in order to determine, so far as the opportunities in this community will allow, the extent to which blood-pressure observations in surgical cases may be of value from a clinical point of view.

The committee will be glad to receive the suggestions of all surgeons who may be interested in the subject and they cordially invite your criticism of the following plan:

(1) It is proposed that a representative of the committee be appointed for each of the hospitals here concerned, the Massachusetts General, Boston City and Children's. This representative of the committee will provide the apparatus necessary for the estimation of blood pressure in clinical cases, and will give such instruction to house officers and nurses as may be needed to obtain a general use of the apparatus. He will, when desired, make observations himself and record results. He will then collect and classify the results for each hospital and assemble them for incorporation in a general report.

(2) No surgical case will be reported except so far as its bearing upon the value of blood-pressure observations is concerned, and no case will be reported without the special consent of the surgeon in charge nor without due credit being given to him in the report.

(3) It is hoped that surgeons will avail themselves of this opportunity to procure blood-pressure observations upon their patients, and that by July 1, 1903, so large a number of clinical observations may be available as to permit the publication of reports which will be of value to the profession.

(4) The co-operation of the Department of Physiology has been secured, in order that a rigid criticism may be brought to bear upon these investigations from a scientific point of view.

(5) The points which have appeared to the committee to be of most importance in this investigation are as follows:

(*a*) Does the Riva-Rocci apparatus indicate the true blood pressure with sufficient accuracy for clinical purposes?

(*b*) In what cases and under what circumstances are the errors due to the apparatus so great as to invalidate its advantageous use?

(*c*) What is the value of blood-pressure observations,
  (1) As an indication for or against operation?
  (2) During the course of an operation?
  (3) In after-treatment of surgical cases?

It is the hope and desire of the committee that general co-operation may be secured in this investigation from all the surgeons on duty in the above-mentioned hospitals, and that a large number of observations may be recorded, in order that a just estimate of their value may be obtained.

Should this investigation, as proposed by the committee, appeal to you as worthy of your support, will you kindly sign and post the enclosed postal card before Feb. 7? A representative of the committee will then call upon you, to ascertain more particularly the extent to which you desire to avail yourself of the committee's assistance and to arrange the details of the undertaking.

Very truly yours,
HERBERT L. BURRELL,
EDWARD H. NICHOLS,
ROBERT B. GREENOUGH,
Committee of the Surgical Department on Research Work.

The response to this letter was practically unanimous, and the committee desires here to express its thanks to the following surgeons who gave permission for the use of their wards for the purposes of this investigation:

Dr. F. G. Balch, Dr. H. H. A. Beach, Dr. J. B. Blake, Dr. W. P. Bolles, Dr. J. T. Bottomley, Dr. E. G. Brackett, Dr. G. W. W. Brewster, Dr. H. L. Burrell, Dr. A. T. Cabot, Dr. Farrar Cobb, Dr. E. A. Codman, Dr. W. M. Conant, Dr. H. W. Cushing, Dr. John Dane, Dr. J. W. Elliot, Dr. W. E. Faulkner, Dr. F. B. Harrington, Dr. J. C. Hubbard, Dr. R. W. Lovett, Dr. F. B. Lund, Dr. S. J. Mixter, Dr. G. H. Monks, Dr. J. G. Mumford, Dr. J. C. Munro, Dr. C. A. Porter, Dr. C. B. Porter, Dr. Abner Post, Dr. M. H. Richardson, Dr. C. L. Scudder, Dr. J. S. Stone, Dr. Augustus Thorndike, Dr. Paul Thorndike, Dr. J. C. Warren, Dr. F. S. Watson.

Dr. W. E. Faulkner, for the Boston City Hospital; Dr. J. S. Stone, for the Children's Hospital; and Dr. F. T. Murphy, for the Massachusetts General Hospital, were invited to exercise a general supervision of the work, and to report upon the value of the results. The Riva-Rocci sphygmomanometer was employed as introduced in this country by Dr. Harvey Cushing, and the apparatus was supplied from various sources. Five instruments were provided for use in the different hospitals. In order that the results might bear comparison, although obtained by different observers, a description of the apparatus was issued and general directions for its use were given substantially as follows:

Description of apparatus. — The apparatus consists of a dilatable rubber armlet, 5 cm. in width, encased in a covering of canvas, which can be adjusted to various sizes by means of hooks and eyes. This armlet is connected by rubber tubing to a rubber syringe-bulb with a dilatable reservoir such as is used with the thermocautery. Inserted between the armlet and the bulb, and connecting with the other tube by means of a Y-shaped joint, is another piece of tubing leading to a mercury manometer, to which is attached a scale graded in millimeters, with the zero point at the level of the mercury. At the distal side of the manometer there is placed an escape-valve closed by a stop-cock, by means of which the pressure in the armlet can be released. The armlet is adjusted loosely to the arm just above the bend of the elbow, with the forearm flexed 30° to 45° and thus held on the same level with the body during the experiment. The armlet is dilated by forcing air from the rubber bulb until the radial pulse is obliterated by the pressure exerted on the brachial artery. At that degree of pressure which just obliterates the radial pulse the height of the column of mercury on the manometer scale is noted and regarded as the systolic blood pressure measured in millimeters of mercury. The reservoir of the manometer should be on the same level as the heart of the patient under examination, and, unless otherwise stated, all pressures are taken with the patient in the prone position. The pulse-rate is counted after the recording of the pressure. After each record the escape-valve should be opened to relieve the constriction before attempting a second reading. In palpating the radial pulse the amplitude of the beat will be noticeably increased during slight compression. With increasing compression it will gradually diminish until lost. Respiratory disturbances and physiological variations may cause some difficulty in getting an accurate reading at the first rise of the mercury column, but by maintaining the level for a few seconds or by the comparison of several readings, this is usually readily obviated. The point at which the pulse can be again palpated after it has been cut off is usually uniformly about 5 or 10 mm. lower than the point at which it disappeared.

The papers presented by Drs. Faulkner, Stone and Murphy represent the conclusions obtained in three different hospitals by different observers. No influence is exerted by the committee on the interpretation of the results, nor upon the manner of their communication. It was only stipulated that the observations be made with the same or similiar apparatus and uniform method of application. The general conclusions of each of these observers are recorded in his report, and a brief summary of the conclusions which appear to the committee to be justified by a consideration of the three series of observations is provided at the end of the communication. In this final summary an attempt is made to answer as correctly as possible the questions propounded in the original circular of the committee.

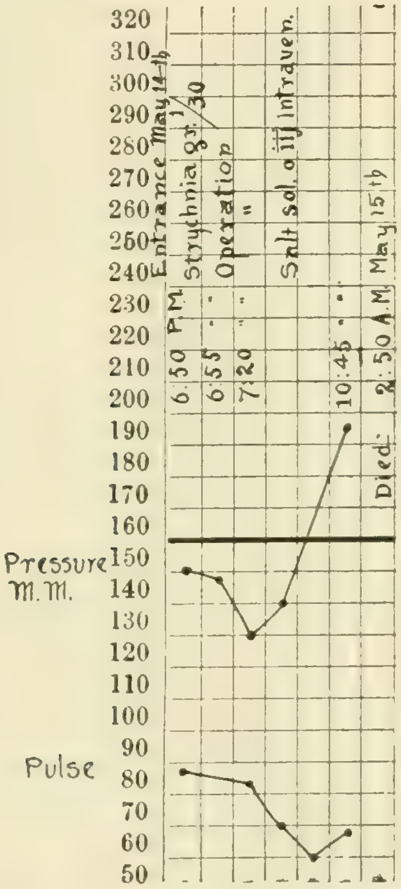
It is assumed in this communication that the Riva-Rocci sphygmomanometer registers more or less accurately the systolic blood pressure. Proof of this assumption, however, so far as is known to this committee, has not yet been produced. Attempts to obtain control observations by the use of an actual arterial manometer in man have not been recorded, and the different conditions in animals are not such as to ensure accurate results. It is the opinion of this committee that a series of such observations upon the human subject, or upon monkeys, is greatly to be desired as a test of the Riva-Rocci instrument. Until this is done, however, a clinical estimate of its value, such as is provided in the following report, is all that can be offered.

REPORT ON BLOOD-PRESSURE OBSERVATIONS AT THE BOSTON CITY HOSPITAL. BY WILLIAM E. FAULKNER, M.D.

THE following cases of blood-pressure observations were made at the Boston City Hospital. The apparatus used was the modified Riva-Rocci sphygmomanometer. The conclusion of the writer is that in the general run of surgical cases blood-pressure observations do not point out dangers that could not be foreseen by observations of the patient's pulse, respiration and general condition, but that in head injuries a high blood tension may be an indication of brain compression when the pulse would not lead us to suspect such a condition.

I. J. M., compound fracture of skull. Service of Dr. Watson. Thrown from horse twenty minutes before entrance. Comatose. Responds to pain and stimulus. No paralysis. Knee jerks and plantar reflexes lively. Ankle clonus. Pupils dilated, right the more. Eyes rotated to right. Comminuted fracture left upper mid-parietal region. Brain substance visible.

Operation. — Ether. Loose bits of bone removed. Brain found much lacerated. Considerable hemorrhage from middle meningeal region controlled by packing. Condition poor at end of operation. Died eight hours after injury.

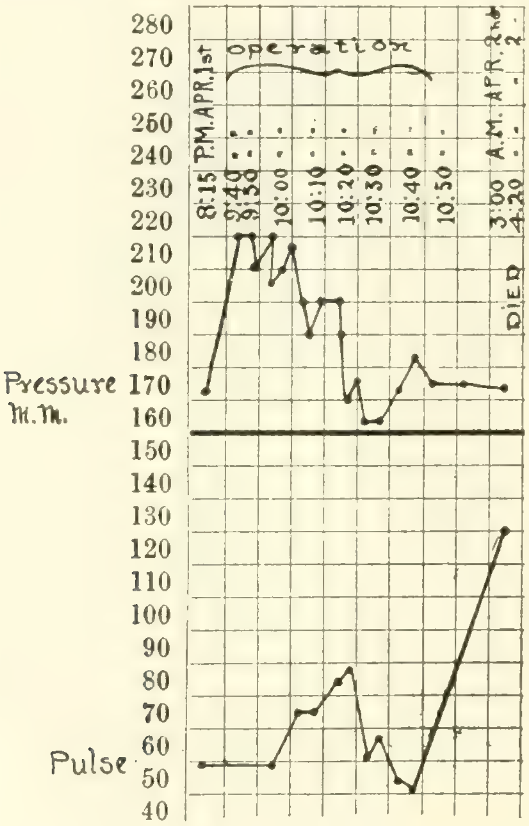


Remarks. — In this case the drop in the pulse-rate is suggestive of compression from a hemorrhage other than that from the middle meningeal, which was controlled by operation. With this was a concomitant rise in blood pressure which may be attributed to the same cause.

II. A. M., twenty-four years. Service of Dr. Watson. Diagnosis, fractured skull. History not obtained. Unconscious, stertorous breathing. Pupils widely dilated, not reacting to light. Laceration and ecchymosis about left eye; blood clot in nose. Pulse 48, full and regular.

Operation. — Without ether trephined on left side over middle meningeal artery. Dura bulging, not pulsating, incised. ℥iv black clot removed. Some red oozing. Drainage. No return to consciousness or response to stimulation. Pupils remain dilated. Breathing stertorous. Died twelve hours after accident.

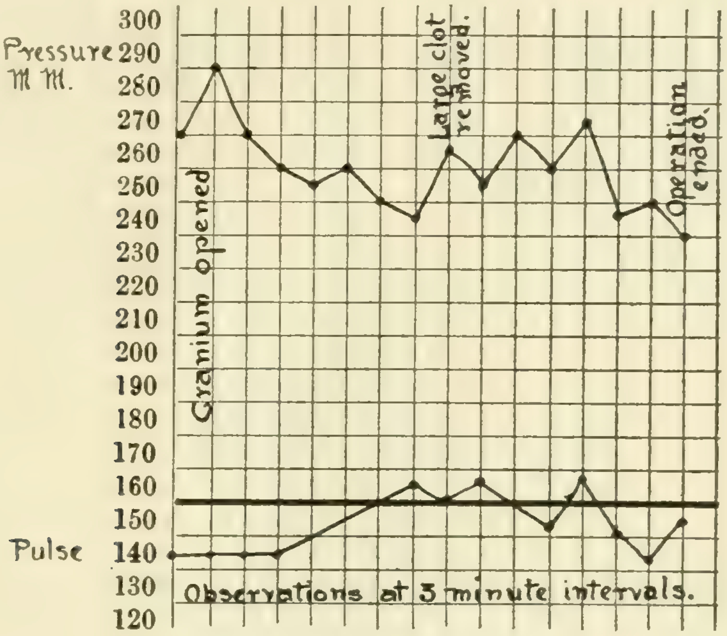
Remarks. — This case showed on entrance a pulse which suggested compression. The blood pressure was not remarkable. During the operation at first the pulse increased in rate and blood pressure in degree. Later both subsided to about the same point as at entrance. Following the operation the pulse took on a rapid increase in frequency until the end came, while the blood pressure remained about the same. Here the pulse told the story.



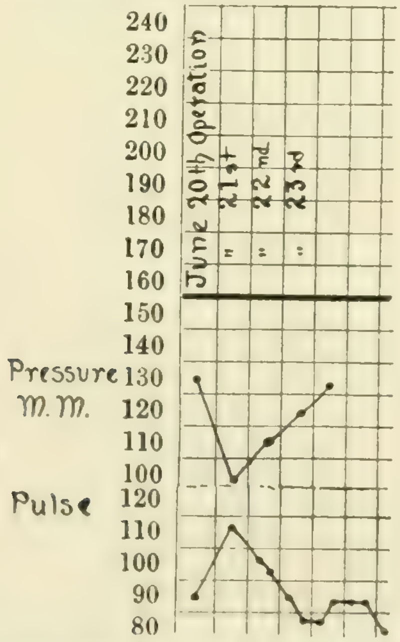
III. J. B., thirty-nine, fracture base of skull. Service of Dr. Bolles. At 9 A.M. thrown from team by collision with electric car, landing on back of head. Unable to get up, but did not lose consciousness until 1 P.M. Entered hospital 7.30 P.M. Well developed and nourished. Flushed face. Stertorous respiration. Left pupil larger than right and does not react. General spasticity of extremities, more marked on right. Knee jerks and plantar reflexes equal. Kernig's symptom left side. Small hematoma in left occipital region.

Operation. — Dr. Hubbard. Trephined over right motor area. No epidural clot. No pulsation of dura. Subdural clot extending toward base removed. No return to consciousness. Less stertorous respiration. Edema of lungs. Died twenty-four hours after accident.

Remarks. — This chart shows a high blood pressure, which can be interpreted as indicative of increased intracranial pressure due to hemorrhage, the drop in the early part of the operation being due to removal of a certain amount of this pressure. The pulse, on the other hand, is that of shock and not at all a "pressure pulse." It would seem that in this case the blood-pressure observations were of distinct value in diagnosticating a cerebral condition.



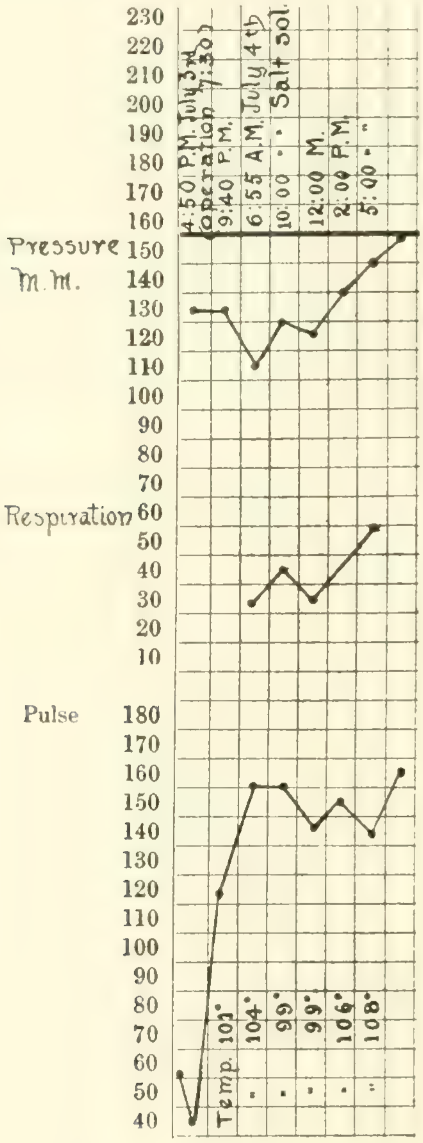
IV. J. K., ten years, depressed fracture of skull. Service of Dr. Cushing. June 20. Hit by ball one hour before entrance. In left frontal region circular depression of skull without external wound. Right pupil larger than left; both react. Involuntary defecation. Vomited once. Somewhat dull.



Operation. — Depression elevated. Small fragments removed. Dura found perforated. Good recovery. June 26. Entirely free from symptoms. Discharged.

Remarks. — In this case of fractured skull the lesion was apparently limited to bone and dura accompanied by slight concussion, and as one would expect neither pulse nor blood tension shows anything remarkable.

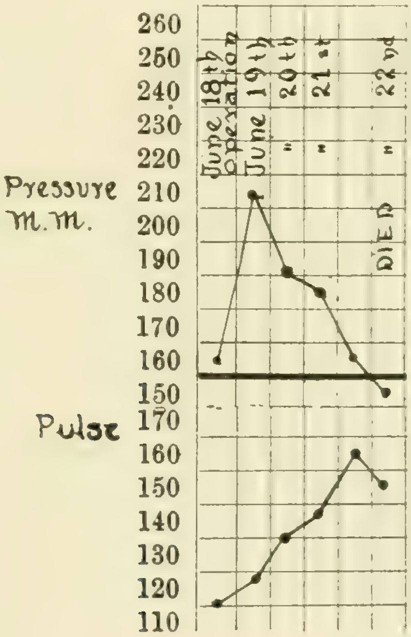
V. Unknown man. Service of Dr. Watson. Found in street. Said to have fallen on sidewalk. Unconscious. Bathed in perspiration. Pupils equally small, not reacting to light at entrance. Later left pupil widely dilated. Slight spasticity of limbs both sides. Ankle clonus right. Abrasion left frontal region. Drop in pulse from 75 to 45 one hour after entrance.



Operation. — Dr. Lund. Trephined over middle meningeal left side. Large extradural clot turned out. Hemorrhage from middle meningeal artery near its entrance into middle fossa controlled by forceps left *in situ.* No return to consciousness. Moved right arm reflexly. Died sixty hours after injury.

Remarks. — In this case the slow pulse of 45 pointed to compression, which was verified by operation. Apparently there was also a serious basal lesion, which manifested itself by the subsequent increase in the pulse-rate and rise in temperature to 108° which came on the next day before the patient succumbed. One might have expected here a high blood pressure to correspond to the " pressure pulse," which, however, was not the case.

VI. J. T., sixty years, fractured skull. Service of Dr. Cushing. June 18, 1903. Fell down stairs previous night. Unconscious. Supraorbital pressure causes drawing up of right side of face and some movement of all extremities. Spasticity of left arm. Knee jerks exaggerated. Plantar reflex normal. In left parieto-occipital region scalp wound down to bone. Bleeding from left ear.

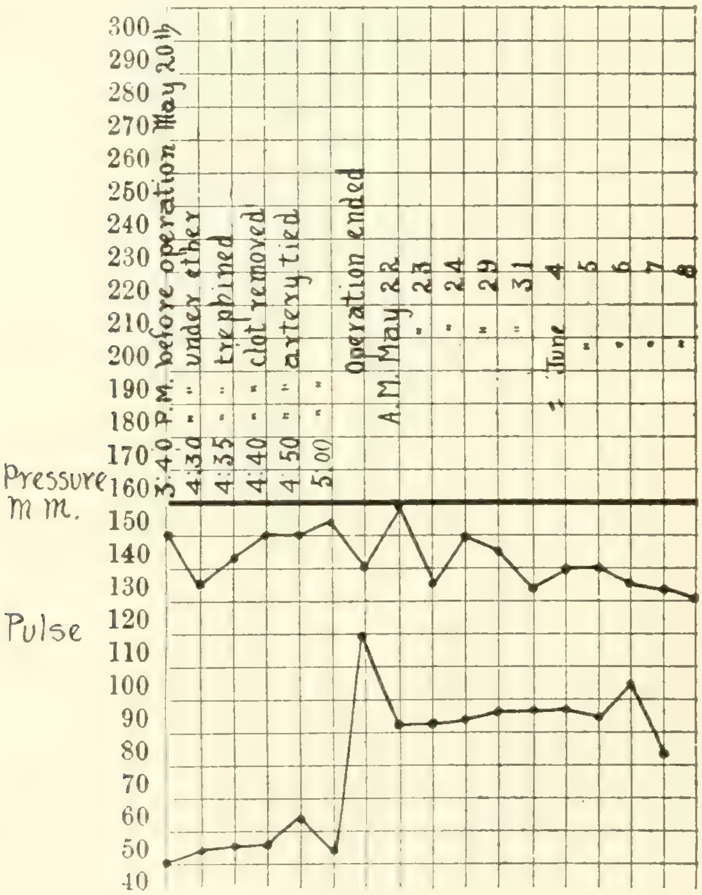


Operation. — Dr. Lund. Fissured fracture found at seat of scalp wound. Skull trephined. No extradural hemorrhage. Dura slightly pulsating opened, with discharge of 3 oz. of serum. Patient died on fifth day without return to consciousness.

Remarks. — In this case we have a patient with blood tension increasing in first twelve hours of observation, indicating possibly increased intracranial pressure. Operation seemed to act favorably in regard to this one symptom. The pulse, which was rapid at the start and which increased in rate as the case progressed, gave a true indication of the alarming condition of the patient.

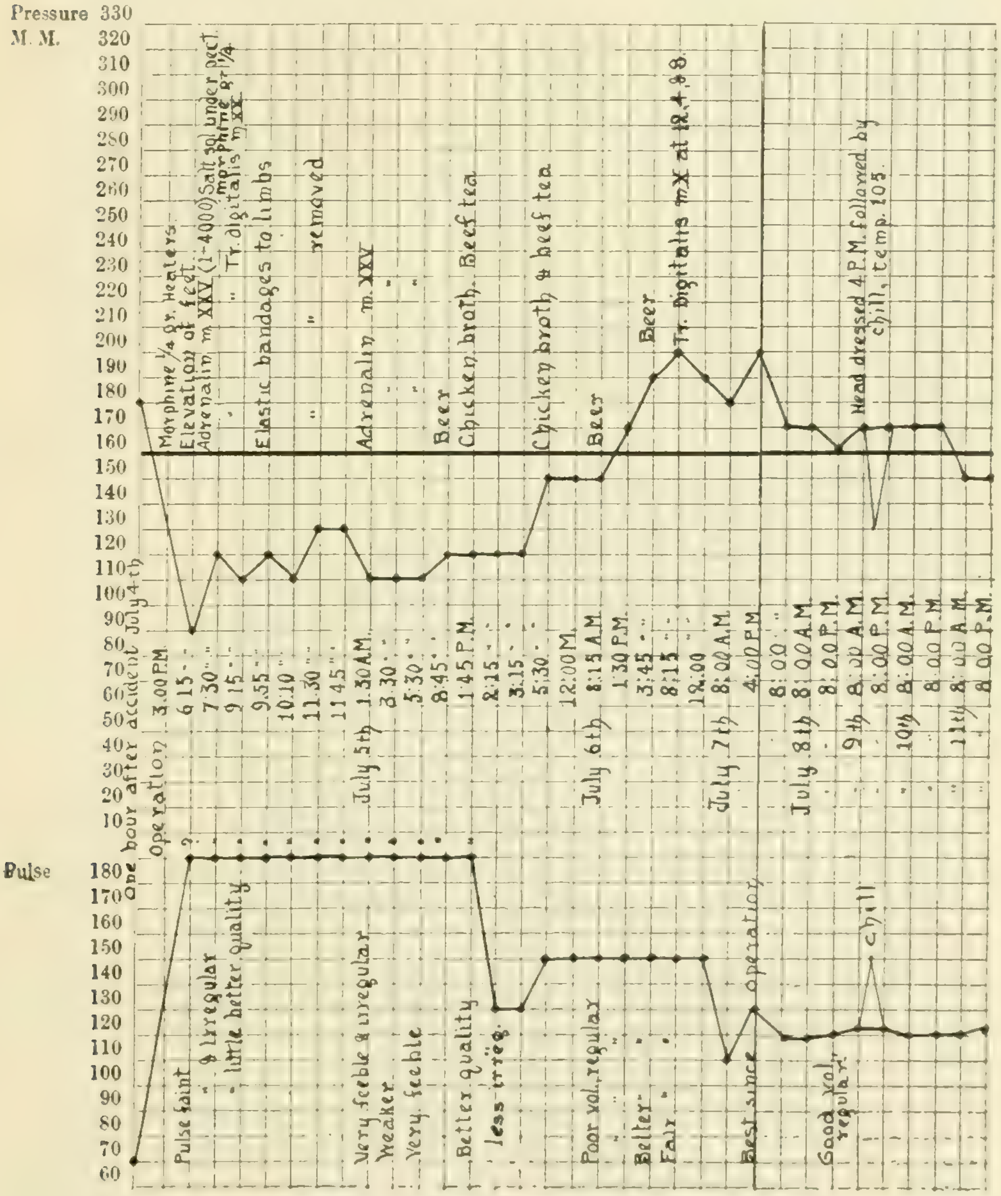
VII. W. K. B., twenty-seven years, compound fracture of skull. Service of Dr. Watson. May 20. Fell on attempting to get on car, striking head on pavement. Stunned but got up and walked three-quarters of a mile; became dizzy, entered drugstore, where he was given something; sat down in park, became drowsy, vomited and later became unconscious. Well developed and nourished. Unconscious. Responds to pain and stimulus. Pupils equal and react to light. Knee jerks lively and increased on right. Ankle clonus increased on right. Babinsky on right. Pulse slow and full to the tactile sense. Hematoma over left parietal region. There was a rumor that the patient was an epileptic, which afterwards proved without foundation.

Operation. — Trephined over hematoma. Fissure fracture with slight depression found. Large epidural clot removed. Hemorrhage from middle meningeal controlled by sutures. Some oozing. Dura uninjured. Wound packed. Patient rational on coming out of ether. Drowsiness on second day (May 22). Small secondary hemorrhage. Considerable clot turned out; wound packed. Wound healed by granulation. Complete recovery.



Remarks. — In this case there was a typical "pressure pulse," which disappeared on removal of clot by operative procedure. The drop in the pulse on the second day, with symptoms of drowsiness, led to suspicion of secondary hemorrhage, which was verified on inspection of wound. The blood-pressure observations were not found to be of any value in this case.

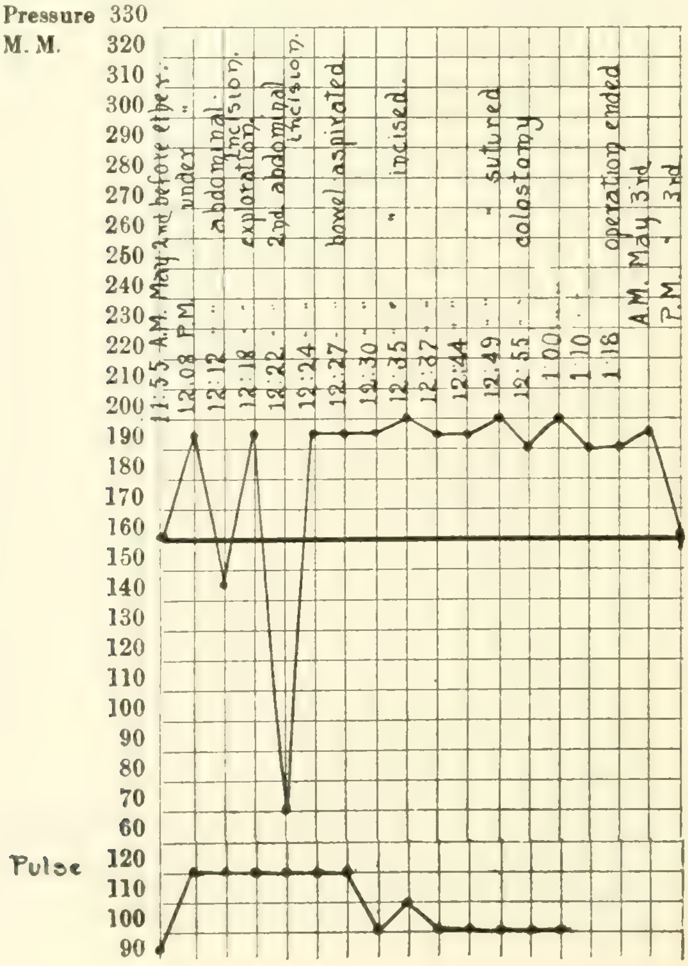
VIII. J. H., twenty-three, compound fracture of skull; compound fracture of left humerus; compound dislocation of left astragalus. Service of Dr. Watson. Team on which patient was riding smashed into by express train. Well developed and nourished. Some shock. Conscious and rational. Multiple scalp wounds. Small opening in skin at lower third of upper arm, with fracture of bone at this point. Astragalus dislocated on to dorsum of foot and skin broken through. No paralysis or abnormal reflexes.



Operation. — Ether. Wounds of arm and ankle cleaned up, deformities reduced and put in plaster. Examination of head revealed fracture with slight depression in parietal region. Skull trephined, large epidural clot turned out. Oozing controlled by packing. Pulse rapid and of poor quality at end of operation.

Remarks. — At entrance the patient's pulse and blood pressure were not remarkable except that the former was slow for a man in moderate shock. Very likely brain compression from blood clot which was subsequently removed had something to do with this. Following operation the patient's condition was that of marked shock for twenty-four hours, as was evidenced by the rapid, feeble, fluttering pulse and low blood pressure. At the end of twenty-four hours the pulse dropped in rate, became better in quality and blood pressure rose. From this time on the patient's condition improved, although the pulse remained rapid for some days. An interesting thing in this case is the lack of reaction on the part of the patient to attempts at stimulation with adrenalin and digitalis, unless the drop in the patient's pulse on July 7 was in part due to the latter drug. The pulse and pressure charts are, roughly speaking, reflections of each other. Both register the patient's condition fairly well.

IX. A. G., fifty-three years, obstruction of bowel. Service of Dr. Watson. Bowels not moved for one week. Some vomiting last few days. No loss of weight. No cachexia. Abdomen slightly tender, much swollen. Tympanites. Temperature 100.

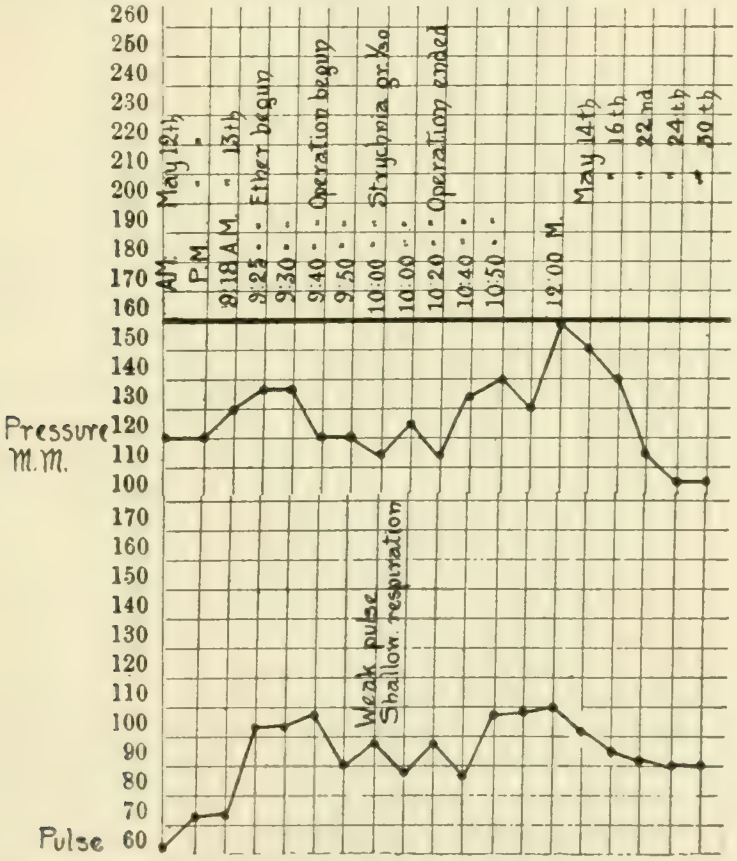


Operation. — By Dr. Watson. Abdomen explored by median incision. Transverse colon opened to let out gas. No tumor found. Left inguinal colostomy. Good recovery.

Remarks. — The patient's condition throughout the operation was excellent, as indicated by the character of his pulse and general appearance. The two drops in blood pressure occurred at points in the operation when the peritoneum was exposed.

X. C. S., fifteen years, tuberculosis of post-cecal glands. Service of Dr. Watson. Abdominal pain at times sharp and crampy. Vomiting. Diarrhea. Abatement of symptoms last three days. Pale, poorly developed and nourished. Chest negative. Abdomen lax and tympanitic. No rigidity. Tumor at McBurney's point.

Operation. — Cecum exposed. Enlarged glands alongside; some broken down. Enucleation of glands. Normal appendix removed. Drainage. Pulse feeble in character toward end of operation. Prolonged convalescence. Discharged with granulating sinus.



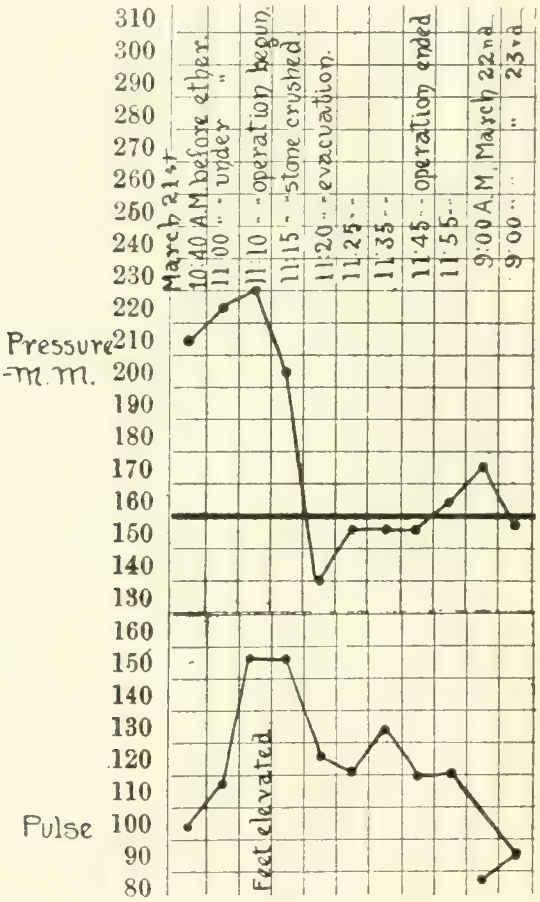
Remarks. — The condition of the patient during the operation, while not alarming, called for stimulation. This was indicated by the feeble character of the pulse and shallow respiration. The blood pressure showed no marked change. It was rather low, as one would expect in an anemic, listless subject.

XI. W. H. P., sixty years, urinary calculus. Service of Dr. Post.

Symptoms of calculus for twenty years. Several previous operations. Well developed and nourished. Some arteriosclerosis.

Operation. — March 21. Dr. Post. Stone crushed. Good recovery.

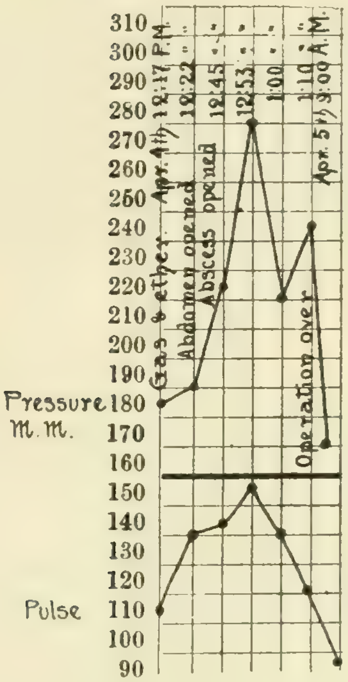
Remarks. — The patient's condition during the operation was excellent. The temporary increase in pulse-rate may well have been due to change in patient's position. The drop in blood pressure to the " normal " corresponds to an improvement in the pulse.



XII. H. P., thirty-two years, abscess in abdominal cavity of supposed appendicular origin. Service of Dr. Watson. Pain in left lower quadrant of abdomen one week. Distinct tumor. Chills.

Operation. — Dr. Watson. Abdominal cavity opened and walled off from indurated mass. The latter incised and drained. Appendix not found. Patient in poor condition at end of operation. Good recovery next day. Fecal fistula; otherwise uneventful recovery.

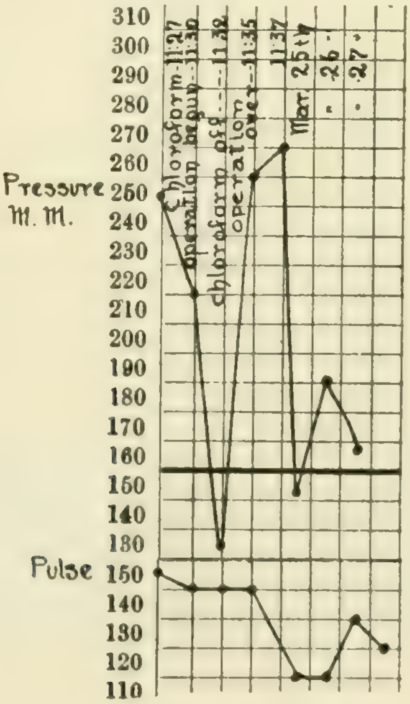
Remarks. — During the operation the pulse increased in rate and to the tactile sense was of poor quality. The patient's condition was such that prolonged search for the appendix seemed inadvisable. The cause of the rapid rise in the blood pressure in this case is not obvious.



XIII. M. C., forty-two years, empyema. Service of Dr. Post. Present illness followed a pneumonia. Patient running a septic temperature. Somewhat delirious. Right side of chest full of fluid. Pulse rapid, but of good quality.

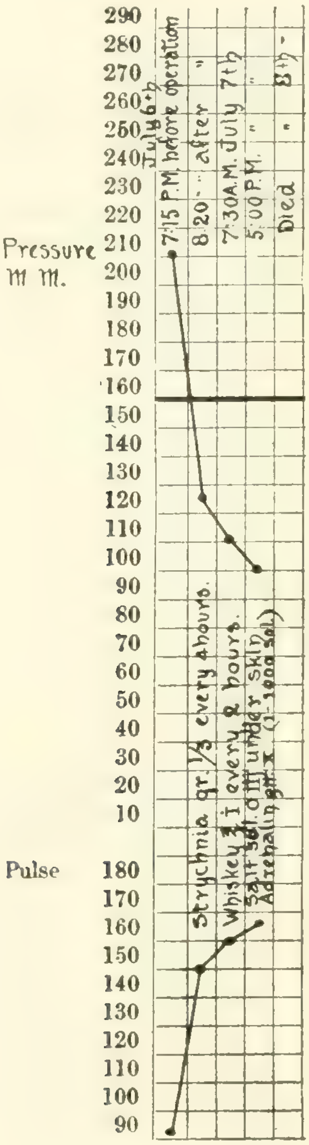
Operation. — Dr. Post. Slight chloroform narcosis. Rib resected. Pus escaped. Salt solution irrigation. Good recovery from operation. Uneventful convalescence. Discharged with slight sinus.

Remarks. — This case shows a marked drop in blood pressure under chloroform anesthesia. The pulse, though rapid, was of good quality throughout.



XIV. O. K., twenty years. Diagnosis, crushed shoulder. Shock. Service of Dr. Watson. Arm run over by steam car one hour before entrance. Well developed and nourished. Pulse slow, fair quality. Marked pallor. Compound fracture of left humerus above middle, with much laceration of soft parts.

Operation. — Dr. Nichols. Under light ether disarticulation at shoulder. Very little hemorrhage. Patient stood operation badly. No reaction to stimulation. Died thirty-six hours after accident.

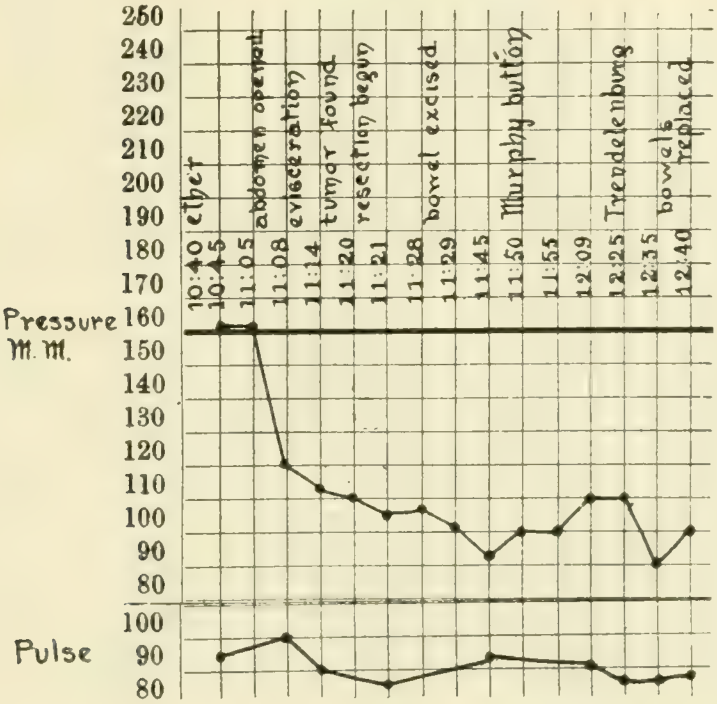


Remarks. — This case shows shock following severe injury, uninfluenced by stimulation. This is quite evident from the pulse curve as well as the drop in blood pressure.

XV. N. P. L., fifty-nine years, carcinoma of intestine. Service of Dr. Cushing. Crampy pains in abdomen for one year. Loss of appetite; troubled with flatus. Slight loss of weight. Fairly well developed and nourished. Skin of grayish hue. Chest negative. Abdomen somewhat distended. Visible peristalsis. Borborygmus.

Operation. — Dr. Cushing. Resection of ileum; Murphy button. "Patient in as good condition after as before operation." Died sixty hours later with onset of sharp abdominal pain and collapse.

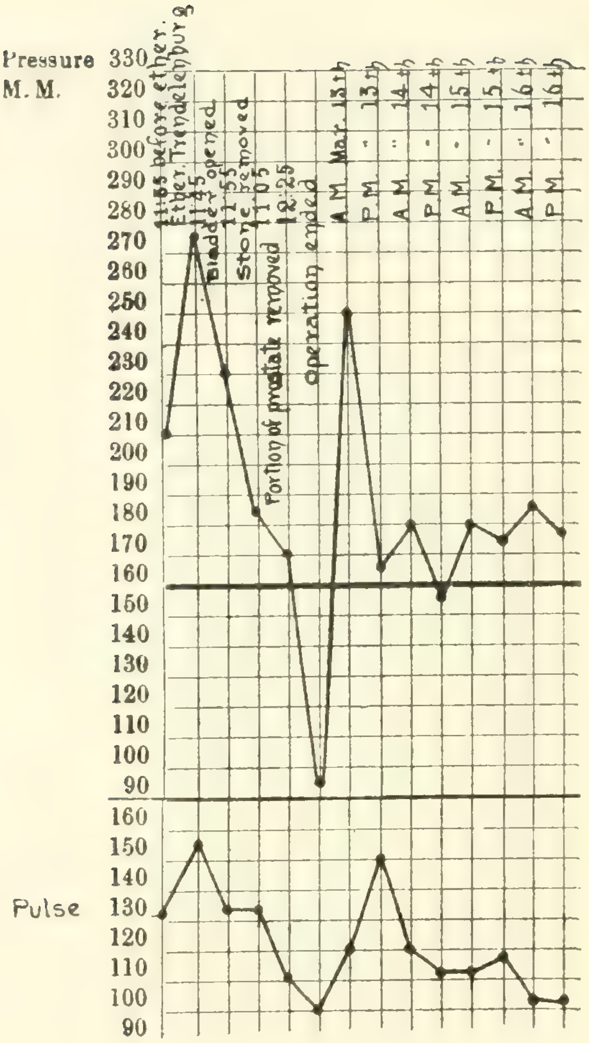
Remarks. — This patient's condition throughout the operation was excellent, although the blood-pressure registration was low except at beginning, where the relatively high registration was very likely due to excitement in first stage of ether.



XVI. P. M., hypertrophy of prostate. Calculus. Service of Dr. Post. March 12, 1903. Three attacks of hematuria in three years with suprapubic pain. Discomfort in riding over rough road. Lately frequency of micturition. Well developed and nourished. Chest negative. Dulness over bladder region. Prostate enlarged. Urine bloody.

Operation. — Dr. Post. Suprapubic cystotomy. Removal of large amount of clot and stone 1½ inches in diameter. Hypertrophied lobe of prostate removed. Good recovery from ether.

Remarks. — The chart shows a rather variable pulse and pressure curve. The elevation of both during the early part of the operation was likely due to position of patient. The drop in pressure at the end of the operation was without significance as far as could be seen.



Report on Blood-Pressure Determinations made at the Boston Children's Hospital. By James S. Stone, M.D.

This report deals with the results of blood-pressure determinations made at the Children's Hospital with the Riva-Rocci manometer. It deals exclusively with surgical patients, and exclusively with children.

A large number of readings were taken with a view to establishing certain absolute determinations. Age was found to play a very important part in the blood pressure. Sixty to 70 mm. is an ordinary reading in infants under six months; 80 to 90 in a child of two or three years; 100 in a child of five or six years; 110 in a child of nine or ten years.

Sex did not seem to make any material difference.

The general health of the child made a very considerable difference in the pressure. Thus, in a child sick with chronic hip disease the pressure might be 20 to 40 mm. lower than it would be expected to be in a well child of the same age. More acute diseases which profoundly affect the general health, as, for example, tubercular peritonitis, did not, as a rule, cause as marked a change in the blood pressure as did the more chronic wasting diseases. In general, the blood pressure fell in proportion to the duration of the disease and the degree of emaciation and weakness which it had produced. In the very acute diseases, such, for example, as appendicitis, where there had not been time to affect the general health, the blood pressure was not materially altered unless by other circumstances. The emaciation of the wasting diseases makes the pulse more easily felt, but at the same time exposes the brachial artery to more ready compression. These two factors tend to balance each other, although probably the latter is more important and tends to lead one to overestimate somewhat the actual fall in pressure.

Certain conditions entirely independent of the health of the child cause very wide variations in the pressure. Crying often raises the pressure from 20 to 60 or more mm. In order to verify this, readings were made on a number of children before and after the visiting hour of the parents. There was no variation in the pressure in the children whose parents had not come to see them, while in those whose mothers had just gone away, the blood pressure was raised often 40, in one case nearly 70 mm. When the children stopped crying the pressure usually fell to the previous level again within ten minutes or often less, but if the child continued to cry slightly and sob, the pressure returned to its former level very much more slowly.

Struggling, coughing, vomiting and retching likewise increase the blood pressure, so that even before etherization is begun in a patient preparatory to operation, the blood pressure may be materially altered from what might be termed normal for the individual. And during the course of an operation under light anesthesia the readings may be similarly changed. Thus the charts must be read with a knowledge of the condition of the patient while undergoing an operation as well as with a knowledge of the steps of the operation. The crying or struggling which accompanies the recovery from full anesthesia at once very materially raises the blood pressure. This change can be appreciated by the eye, independently of any observation of the pulse. It is not uncommon for an operator to become anxious because of the appearance of a child, especially if considerable blood has been lost. The ether is removed, consciousness of pain returns, the child cries, the color at once improves. These changes can be observed most readily in harelip or other operations on the face.

Posture likewise has a very decided influence on the blood pressure, owing to mechanical interference with respiration or with the action of the heart and to the amount of blood supplied to the head. Turning the patient on to the side during an operation may cause a fall in pressure of 10 to 25 mm. — a fall which is promptly overcome when the patient is turned on to the back again. The changes in the relative elevation of the head and trunk, such as occur in the use of the Trendelenburg table, have probably less influence on the pressure in children than in adults, but no definite observations on this matter have been made.

Before speaking of the influence of hemorrhage, operative procedures and shock on the blood pressure in children, I must state that the Children's Hospital is without an ambulance service and that since these observations were begun in March I know of no child admitted in a condition of profound shock or after severe hemorrhage — conditions met with every day in the Massachusetts General and Boston City hospitals. In the Children's Hospital, likewise, severe abdominal or cerebral operations are extremely rare, so that there are but few data from which to judge in those cases in which pressure readings promise to be of most value.

Ether causes practically always a rise in the pressure from 5 to 20 mm., averaging perhaps 10 mm. This rise occurs very promptly and lasts for some time. That it is not a result of the struggle against taking ether is, I think, wholly proved by the fact that it continues so long and that it occurs where there has been no struggle. Occasionally there is a slight fall instead of a rise, apparently due almost always to confusing circumstances.

This primary rise due to the ether was ordinarily followed by a much slower drop in pressure in cases in which the operation itself was so slight that it could exert but little influence in this particular. The operation, if one in which the shock was insignificant, semed sometimes to cause a slight rise in pressure in addition to the rise caused by the ether, but if the operation were prolonged and the operative procedures were severe, the fall in the pressure seemed a little more marked than it would have been had the child been simply kept under ether during an operation which was prolonged but in which the operative procedures were not such as to cause shock. In ordinary operations this secondary fall did not often bring the pressure down to the starting point before etherization; it practically never brought it lower.

In some operations in which marked changes might be expected for purely mechanical reasons, the blood-pressure readings showed nothing of value. For example, in several operations for empyema the blood pressure showed no marked or definite changes. Probably the coughing and struggling under the light anesthesia counterbalanced any variations due to the changes in the lung and pleural cavity.

Ordinary abdominal operations, such, for example, as the drainage of an abscess and the removal of the appendix, showed little variation in the blood pressure. Sometimes there was a very slight rise, followed by a fall equally slight, and never to the starting point. In the other severe and prolonged operations the blood-pressure readings failed to indicate the onset of shock.

Thus, for example, during an operation for the removal of sarcomatous lymphatic glands from the pelvis, the blood pressure, which before the ether was started was 105 and which rose during the first part of the operation about 15 mm., at the end of the operation, which lasted an hour and a quarter, had not quite fallen back to the starting point. During this operation the pulse-rate seemed a more accurate guide to the child's condition than the blood pressure. Thus, at the end of three-quarters of an hour, in which glands had been dissected out from along the internal iliac vein and high up along the common iliac vessels, the lips had become pale, the color poor, the skin had become cold, the child had begun to sweat profusely, the respirations had become feeble, the pulse-rate had increased 30 beats, and yet the blood pressure had dropped but 5 mm. from what it was during the earliest part of the operation at the time of the primary rise due to the ether and still remained higher than it had been before the ether was begun.

On the other hand, during the two days following the operation the pulse-rate gradually came down, while the blood pressure also became lower, averaging 10 mm. lower than before the operation began and 20 points lower than during the last part of the operation, when the shock seemed greatest.

In one case a laparotomy was performed on a child with a pulse so poor that no reading could be made.

In another case, an operation for empyema, the radial pulse was so poor that the readings had no value whatever.

In the only head case observed, one of concussion due to a fall from a third-story window, the blood pressure showed nothing.

The effect of the fracture of large bones upon the pulse-rate has often been noticed. The respiration is also often affected. The observations made during osteoclasis of the tibia and fibula and osteotomy of the femur showed that the blood pressure was also affected in varying amount. Thus, the pulse-rate immediately after the break increased from 10 to 30 beats, while the pressure, which in one case for the few seconds before the snap came and while the bone was withstanding the tremendous strain put upon it, seemed to drop a little, rose from 5 to 30 mm. just after the snap. Comparing the pulse-rate and blood pressure after osteoclasis with what existed before the ether was started, we find the same conditions as exist in any simple operation, namely, a slight increase in the pulse-rate and a slight rise in the blood pressure. The slight amount of shock caused by the fracture of both legs is not indicated by any fall in the blood pressure either immediately or after the preliminary rise.

In the same way during forcible manipulations about the large joints, such as the reduction of congenital dislocation of the hip by the Lorenz method or by the Bartlett machine, which exerts tremendous traction, the blood pressure rose slightly, 5 to 10 mm., while the force was being exerted, but dropped afterward to, but not below, the point at which it had been at first.

Operations involving profound stimulation of the cutaneous nerves, as, for example, the removal of Thiersch skin grafts, caused a slight rise in the pressure, about 5 mm., but the fall in the blood pressure afterward was insignificant at first and later did not correspond with the shock incident to the prolonged operation.

In spite of the failures of the Riva-Rocci manometer to indicate the onset of shock, blood-pressure observations may be of value in preventing the unnecesssary use of cardiac stimulants. The observations made at the Children's Hospital suggest that the readings indicate as much the strength of the cardiac systole as they do the general blood pressure. If this is true, the observations bear out the contention of Crile that in shock the heart, at first at all events, performs its work adequately. The Riva-Rocci readings may hasten the abandonment of cardiac stimulation when the heart is performing its work adequately, a stimulation which, if it has an effect at all, tends to fatigue the heart. The readings show nothing which ordinary clinical observation has not shown before, but because they can be recorded graphically they may have a more marked influence. Likewise, the recognition of the fact that stimulation is useless in chronic wasting diseases, such as the forms of surgical tuberculosis, may be hastened.

CONCLUSIONS AS TO THE BLOOD PRESSURE IN THE SURGICAL DISEASES OF CHILDREN.

Ether causes a rapid rise in the blood pressure as indicated by the Riva-Rocci apparatus.

This rise is followed by a very much slower fall in the pressure.

Ordinary operative procedures seem sometimes to increase the pressure slightly.

With the establishment of shock the pressure is lowered, but—

Other signs of shock, the more rapid pulse, the more feeble respiration, the cold, clammy skin, are noted earlier during operations than is a drop in blood pressure.

Conversely, patients practically pulseless at the wrist can withstand operations.

Crying, vomiting, retching, struggling or changes in position affect the blood pressure so much more than ordinary operative procedures as often to render pressure charts practically valueless, unless all these circumstances are noted.[1]

SEPTEMBER, 1903.

REPORT ON BLOOD-PRESSURE OBSERVATIONS AT THE MASSACHUSETTS GENERAL HOSPITAL. BY FRED T. MURPHY, M.D.

OBSERVATIONS were made in the wards of the Massachusetts General Hospital on 100 surgical cases. These cases were to a certain extent selected as being those which promised to give valuable and characteristic data. In these the pressure was taken for as long a time as there seemed to be any hope of a change and at four-hour intervals, or twice a day, though in a few it was possible to obtain only a daily reading. During the operations the pressure was practically watched constantly, and in conditions where sudden changes were probable the readings were taken at intervals varying from one to fifteen minutes. The observations were made in accordance with the instructions detailed in the circular and with the Riva-Rocci apparatus therein described, except that a broad (10 cm.) band with a metal armlet was used in the latter half of the cases examined. The broad and narrow bands were not used on the same case, or, if so, a control observation was made so that the different levels should not be confused. Of necessity, many of the readings were taken by the nurses and house officers, to whom I wish to express my thanks, but in all instances their observations were controlled by mine. Numerous other isolated readings were taken which were considered too scattered and irregular to warrant consideration.

The figures in the following report represent the systolic blood pressure expressed in millimeters of mercury.

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[1] Many of the blood-pressure observations here reported were made by the house officers of the Children's Hospital, to whom the writer would here express his thanks.

There were 28 cases of head injury of varying types, of which 18 recovered and 10 died. These " head cases " are reported with considerable detail, as in injuries of this nature the blood pressure promises to give the most definite conclusions. The 18 cases which recovered will be first considered.

Two typical pressure cases with localized paralysis from middle meningeal hemorrhage were seen only after operation and, as might be expected, the charts are not remarkable, one showing a level at 100 to 80 and the second running along at 120 to 140.

Five cases, all with low-frequency pulses, diagnosticated as concussion, the degree varying from a mild shake-up to complete unconsciousness, gave readings for the first twenty-four hours at levels between 85 and 180.

Five cases of fracture of the base without operation, the diagnosis resting on bleeding from the ears or sub-conjunctival hemorrhage with slow pulse and stertorous respiration and loss of consciousness, showed levels of from 110 to 190 without marked variation, except in one case, where the chart might be misleading as indicating a pressure which demanded interference (see Fig. 1). The abrupt rise of 35 mm. may be interpreted as the result of compression or reaction from the shock of injury. (Service of Dr. Elliot.)

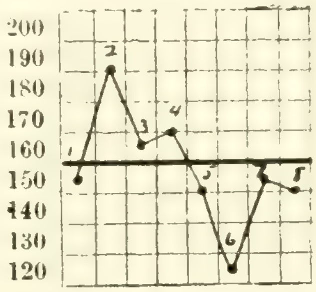

Fig. 1. — 1. In accident room late in P.M. 2. 10 P.M. 3. Midnight. 4. 3 A.M. 5. 6 A.M. 6. 11 A.M. 7 & 8. Succeeding days. Pulse 70 to 80.

Three cases of compound fracture of skull are interesting only from the low level of one, 85 to 70, which was maintained during the afternoon following operation.

A case of probable fracture of the base, which had been operated upon about one year previously for an extensive compound fracture, deserves special mention. Since operation the man had been subject to epileptic attacks, and in one of these he had fallen down stairs, striking on his head. For the first forty-eight hours after the injury he had been at home in a semi-conscious state. During the second twenty-four hours before entering he had complained of pain in the head and had vomited several times. Also it was noticed that the scar, which had formerly been depressed, was bulging. On entrance, the patient was semi-conscious, pulse about 50 and temperature 101. No paralysis. The bulging area in the frontal region pulsated synchronously with the radial, and pressure upon this area caused extreme pain. During the next forty-eight hours there was no change. On the third day a lumbar puncture was done, two test tubes of clear fluid being withdrawn, with the disappearance of the tumor and relief of pain for twelve hours. Unfortunately, no blood pressure was taken at the actual withdrawal of the fluid, but the level of the afternoon reading was not altered. On the fourth day there was a marked facial paralysis and involuntary movements of the bowels. Leeches were applied over the tumor without change to size or in the blood-pressure reading. On the fifth day the clinical condition was the same, but the blood pressure had fallen practically to the level maintained during convalescence. During the next twenty-four hours the improvement was marked. Here the blood pressure seemed to indicate a change before the usual clinical signs (see Fig. 2). (Service of Dr. Warren.)

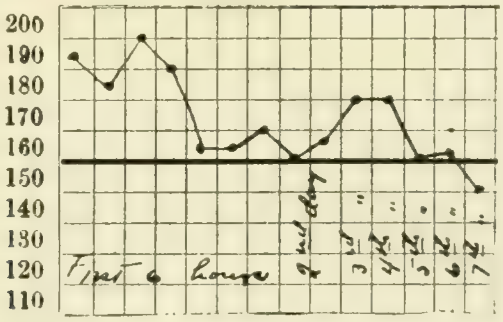

FIG. 2.

A case of tic douloureux was followed during a primary operation for the exposure of the Gasserian ganglion, and six days later during the operation for its removal. Excepting a rise to 180 before taking the anesthetic, the blood pressure did not vary over 10 mm. from the level of 150 in the first operation and 140 in the second, though the hemorrhage was severe and the manipulation of the brain at times extreme. Nor was there any change when the ganglion was divulsed. A second case of operation on the ganglion, with the exception of the rise in pressure due to the ether, held a level of 120 without greater variation than the first. (Both cases on service of Dr. Mixter.)

Of the 10 cases which died, 3 fractures of the base dying within the first twenty-four hours kept a level of 130, 150 and 190 respectively until the moribund drop. This final decline in the blood pressure was constant in all types of cases, the time of its onset varying between wide extremes and with the degree of the general collapse. The temperature, pulse or general appearance of all these cases indicated a hopeless condition.

A case of concussion, so called from negative symptoms, showed a four-hourly chart with a rise from 80 to 110 during the first sixteen hours, though the temperature had gone from 101.8 to 107.

A hopeless fracture of the skull gave a pressure after the operation of 120, with a pulse-rate of 140, and in a case of intracranial hemorrhage on both sides, as proved at autopsy, which had been operated upon with removal of the clot only from one side, the blood pressure was negative, as indicative of local or general condition.

Another case classed as concussion gave the following chart, which had been reduced from a four-hourly to a 2 i. d. Lumbar puncture, with withdrawal of two test tubes of fluid, caused no permanent or immediate change in the pressure. The pulse went to 140 on the eighth day and the temperature to 104.5, forty-eight hours before death. Died in the afternoon following the last record (see Fig. 3). (Service of Dr. Richardson.

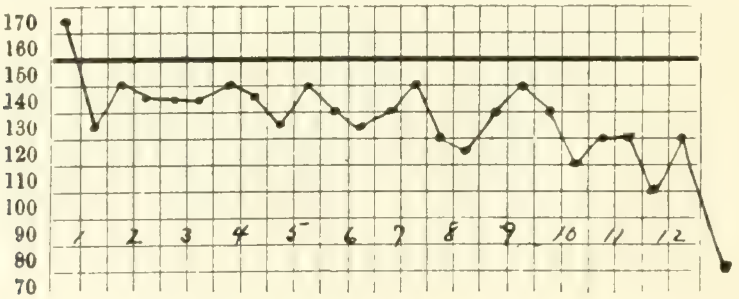

FIG. 3.

The chart of a case in which a blasting accident blew off the whole frontal region, with laceration of the brain and the face, is given because of the low pressure on entrance, on April 6, the failure to show any change at the section of the optic nerve in the operation for the enucleation of the eye and the clearing up of the lacerations and the marked rise which antedated by three days any suggestive change in the pulse or temperature. The nature of the wound was such that an infection was inevitable and at autopsy a pneumococcus meningitis was found. Sepsis rather than compression would seem to have been the cause of the abrupt rise in the blood pressure (see Fig. 4). (Service of Dr. Richardson.)

A second case of compound fracture of the skull, which from clinical signs died of meningitis, is included for comparison with the preceding. Here the temperature shot to 105 on the 25th and the pulse began its final rise on the 28th. Irregular four-hour chart reduced to a 2 i. d. (see Fig. 5). (Service of Dr. Elliot.)

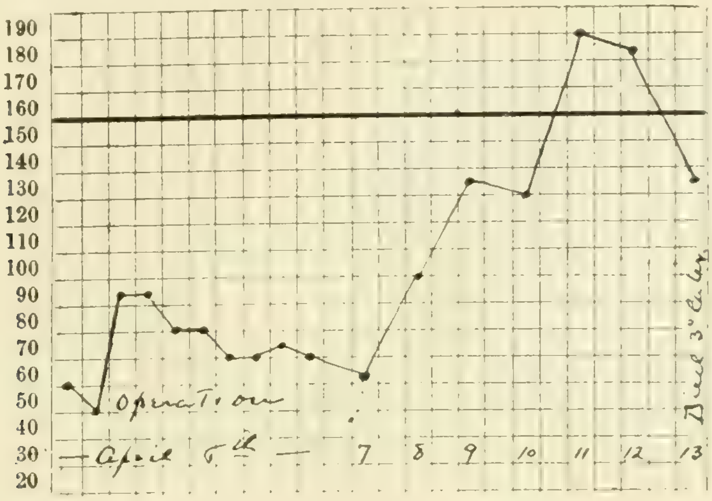

FIG. 4.

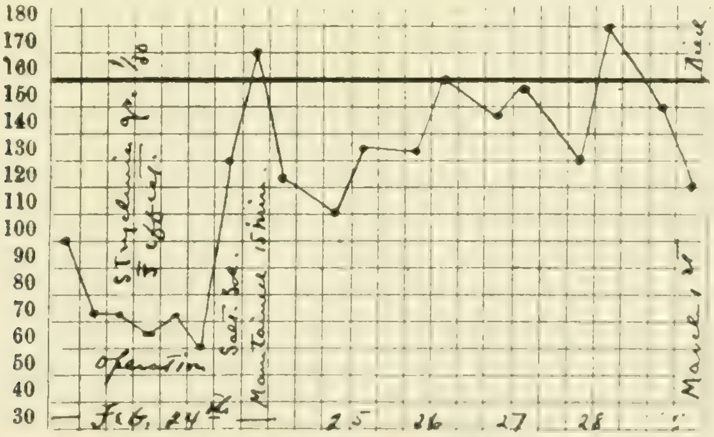

FIG. 5.

The final head case, a fracture of the base with laceration of the brain, as shown at autopsy, gave the following chart, which was reduced from a four-hourly to a 2 i. d. At operation the dura was very tense and cerebrospinal fluid escaped as if under great pressure, but, as can be seen, excluding the elevation at the beginning of the operation, which was probably due to the ether, there was no marked change, the afternoon reading being 10 mm. higher than the morning. On the 28th the temperature went to 105, where it remained and the pulse shot up on the 27th, but until the final drop on the 29th the pressure record is not remarkable (see Fig. 6). (Service of Dr. Elliot.)

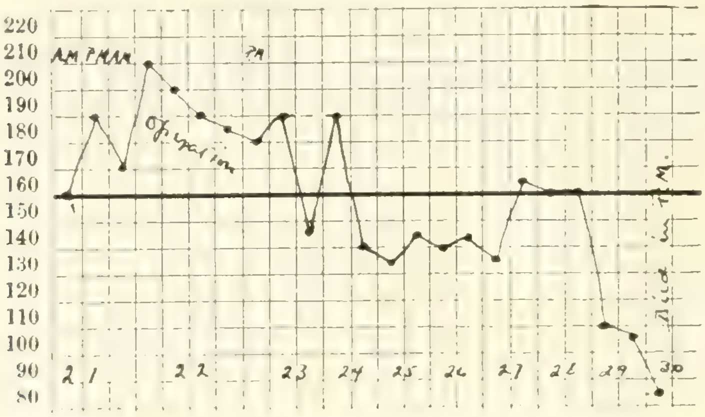

FIG. 6.

The negative charts of the 18 cases which recovered may be considered as confirmatory of the other clinical signs. The failure of the 10 fatal cases to show more diagrammatically any increase in the intracranial pressure or to indicate more clearly the general condition emphasizes the influence of diverse factors in such injuries. That cerebral compression of sufficient degree does, up to a certain point, increase the tension of the pulse, is an accepted fact based on clinical experience. The Riva-Rocci or other apparatus simply records this graphically. The influence of shock, hemorrhage and dyspnea is not, however, to be disregarded. Only by considering their influence on the blood pressure, together with the previous as well as the present general condition of each individual case, does it seem that a safe balance could be struck. The blood pressure here, perhaps, more than in any other type of injury, is the sum total of such varying influences that it must fail to be typical in many instances. Judged from this series, the blood pressures as isolated data are disappointing. They failed to assist materially in determining the surgical condition. No level or curve, excepting the final decline, was constant. The definite, graphic record, however, of a quantity which is accepted as being influenced by variations in the degree of intracranial compression should give valuable data in certain cases when combined with the other symptoms.

Routine cases as seen in the accident room and wards will be considered under one general group.

The extremes, as taken on accident-room cases, were 65 and 235. The former, a case of railroad accident with a compound fracure of both bones of the right arm and leg, a fracture of the ribs and questionable fracture of the pelvis, made a good recovery. The blood pressure confirmed the clinical diagnosis of extreme shock. The latter, an acute retention, was relieved and walked out. This high tension doubtless went with the arteriosclerosis and probable kidney complication.

Shock in varying degrees is illustrated by the following cases: A superficial and not extensive burn entered with a pressure of 235, which within an hour dropped to 190 to 200, where it remained. A fatal general burn gave, on an half-hourly chart, a pressure of 120 to 105 during the first day, with two drops to 90, which were held for one hour. In the night the radial pulse was too weak to give a reading, but the next day a pressure of about 70 existed. Again at night the pulse was lost and the patient died the next day. Here strychnia, atropin and subcutaneous infusion of salt solution caused no rise. (Service of Dr. Beach.) A case of fracture of the thigh, color good, pulse at 70, had a pressure of 170; another fracture of the thigh, mild shock, pulse of 100. had a pressure of 190; a compound fracture of the thigh, general condition poor, dying that afternoon, gave a pulse of 140 and a pressure of 165; a bad crush of the shoulder with ultimate recovery, but too weak to allow immediate operation, showed the pulse at 110 and pressure 110; a crush of arm and leg, hopeless, dying in a few hours, had a pulse of 110 and pressure of 125, and so on.

Judged by the immediate reaction and the subsequent course with varying degrees of shock, the blood pressure generally confirmed the other clinical signs, but in many instances the height of the level maintained was misleading. Here again the moribund fall appeared to be the one constant feature. The general appearance, respiration and pulse-rate gave in all instances a better idea of the condition than could be obtained by judging from the blood-pressure readings.

The acute abdominal cases observed before operation were only a few, but there was no suggestive level, rise or fall in the blood pressure. No case was observed before and during the onset of acute abdominal infection.

Anesthesia is commonly given at the Massachusetts General Hospital as follows: Nitrous oxide gas is administered with a Bennett inhaler and ether is substituted when the gas anesthesia is complete. The pressure under these conditions is quite typically shown in the following chart; that is, a preliminary rise with the gas, then a fall of 10 to 20, followed by a sudden elevation of 30 to 40 at the first of the pure ether, and then a gradual drop to a level 10 to 20 above the original base line. While this scheme held in general, exceptional elevations of as much as 100 mm. were noted under the early ether (see Fig. 7). (Service of Dr. C. B. Porter.)

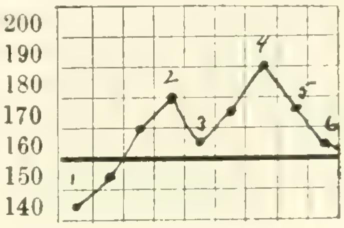

FIG. 7. — 1. Before starting gas. 2. Straining under gas. 3. Under gas. 4. Straining under ether. 5. Easy breathing. 6. Ready for the table.

Charts of different operations are given to illustrate the effect as shown by the blood pressures.

Operations of the type clinically supposed to produce no shock, such as interval appendectomy, hernia, etc., may be exemplified by a chart of simple drainage of the gall bladder (see Fig. 8). (Service of Dr. Beach.)

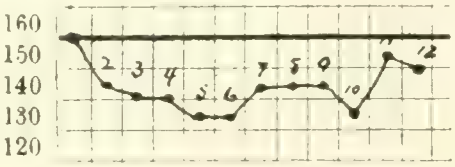

FIG. 8. — 1. Partially etherized. 2. Beginning operation. 3. Opening belly. 4. Digital exploration. 5. Walling off. 6. Aspirating gall bladder. 7. Probing for stones. 8 & 9. Tying in Mixter tube. 10. Moving gauze. 11. Manipulation of the common duct. 12. End of operation.

In a case of rupture of the spleen in which there was, of necessity, rough manipulation of the intestines and parietes and where a counter-opening was made in the loin, the variations are not striking (see Fig. 9). (Service of Dr. Elliot.)

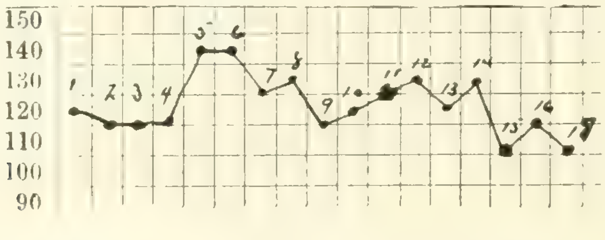

FIG. 9. — 1. Belly wall. 2. Opening belly. 3. Handling intestines. 4. Salt solution washout. 5. Walling off. 6. Salt solution washout. 7 & 8. Rough handling of intestines. 9 & 10. Packing on spleen. 11, 12 & 13. Sewing up. 14. Opening in loin. 15. Packing on spleen. 16. Sewing up. 17. End of operation. Pulse 80 to 120.

The following chart of a case of high amputation of the arm, which was all but in extremis from sepsis, is remarkable only from the graphic fall in the blood pressure when the patient was dying (see Fig. 10). (Service of Dr. Warren.)

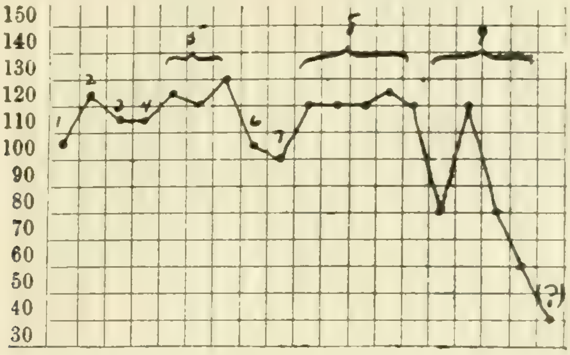

FIG. 10. — 1. Before operation. 2. Primary ether. 3. Circular incision down to bone. 4. Sawing bone. 5. Tying off and applying dressing. 6. End of operation. 7. In ward immediately after operation. 8. Salt solution intravenously, 1½ pints, level maintained eleven minutes. 9. Following at five-minute intervals. Pulse 90 to 140. Patient died a few minutes after the last record.

An omentopexy gave the following record (see Fig. 11): (Service of Dr. Conant.)

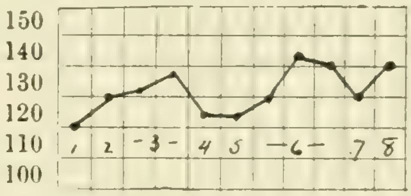

FIG. 11. — 1. Belly wall. 2. Opening belly. 3. Exploration. 4. Rubbing peritoneum. 5. Rubbing liver. 6. Sewing up omentum. 7. Sewing up. 8. End of operation. Pulse 110 to 100.

A fatal strangulated hernia in an old man who seemed to be in a very bad condition, color poor, pulse 120 and respiration labored, gave this chart (see Fig. 12): (Service of Dr. Beach.)

A general peritonitis in a child of seven, in an extremely bad

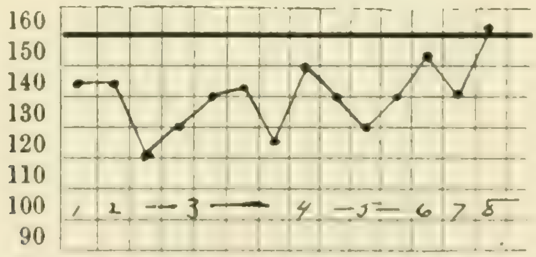

FIG 12. — 1. Sac opened. 2. Manipulation of bowels. 3. Resecting gut and putting in Murphy button. 4. Two minutes after atropin gr. $\frac{1}{80}$ subcutaneously. 5. Sewing up mesentery and closing abdominal wall. 6. Straining under light ether. 7. End of operation. 8. One hour later in ward. Pulse 95 to 120.

condition, gave this record (see Fig. 13): (Service of Dr. Warren.)

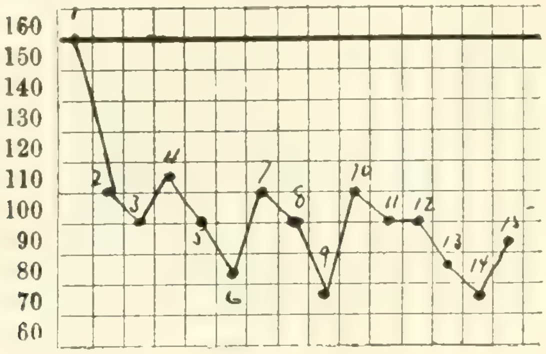

Fig. 13. — 1. In accident room. 2. Just on table. 3. Belly wall. 4. Straining under light ether. 5. Exploration. 6. Salt solution washout. 7 & 8. Removing appendix. 9. Washout. 10. Three minutes after strychnia gr. $\frac{1}{40}$ subcutaneously. 11 & 12. Wicks. 13 & 14. Sewing up. 15. Close of operation. Pulse 140 to uncountable.

A case similar to the above in an adult showed the following chart (see Fig. 14): (Service of Dr. C. B. Porter.)

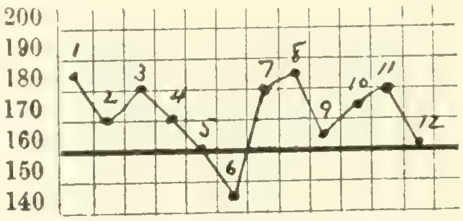

Fig. 14. — 1. Under ether. 2. Belly wall. 3. Peritoneum opened. 4. Exploration. 5. Exploration of pelvis. 6. Salt solution washout. 7 & 8. Wicks. 9. Further exploration. 10. Sewing up. 11. End of operation. 12. In ward one hour later. Pulse 106 to 120.

A case of extra-uterine pregnancy with rupture and intraperitoneal hemorrhage reacted in this diagrammatic manner (see Fig. 15): (Service of Dr. Warren.)

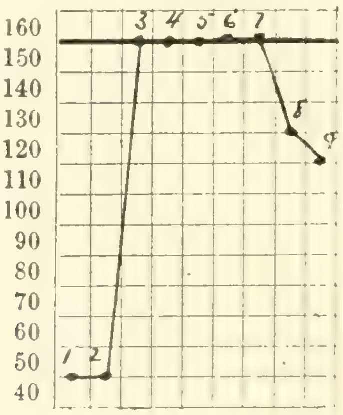

Fig. 15. — 1. Opening belly. 2. Straining under ether. 3. After one pint salt solution intravenously. 4. Right tube removed; salt solution up to 1½ pints. 5. Salt solution up to 2 pints. 6. Intestines washed out of belly. 7. Sewing up. 8. End of operation. 9. Thirty minutes after operation. Pulse of 130 to 150.

The blood-pressure curve during the operations did not give so accurate an idea of the general condition as the routine clinical signs, — pulse, respiration and general appearance. Changes were noted earlier by judging from the composite picture, and as substantiated by subsequent course the blood pressure alone might be most misleading. This was true both as indicating a good as well as a poor condition.

Operations on the pelvis, necessitating the Trendelenburg position with its changing levels, so confused the readngs that they were useless.

Isolated cases of possible interest were: An adrenal tumor with metastasis in the brain, with sufficient pressure to press forward through the vault, ran along at 105 to 115; a kidney decapsulation ten days after operation showed a level at about 140; a case of nephrectomy, which later died, gave some months after the operation a pulse of 80 and a pressure of 210 to 280; two cases of tetanus had, as might be expected, high pressures of from 210 to 240; a case of septicemia, which was running a temperature of from 100 to 107, and which was being treated by intravenous injections of formalin, ran an irregular daily chart of from 90 to 120 until the final drop, the temperature seeming to have no close relation to the pressure; a fatal case of hemorrhagic jaundice held a level of 140 to 120, with a pulse at 150 to 160 without noticeable change from strychnia, atropin or gelatin subcutaneously; a polyp of the uterus, which had caused such hemorrhage as to reduce the hemoglobin to 40%, gave a pressure of 205 and a pulse of 125. This last case might be interpreted either as showing the pulse to be much stronger than was estimated by digital compression or as giving a high blood pressure which was due to the size of the arm and other conditions, and which did not estimate accurately the pulse force. The case went on to final recovery, but, on the day when the pressure of 205 was recorded, she was in such poor condition that the prognosis was decidedly doubtful. Dr. Torbert very kindly took observations for me on six cases of eclampsia at the Boston Lying-In Hospital. During the convulsions the blood pressure ran along between 225 and 240. After the acute stage the pressure fell gradually to levels varying between 140 and 160, the changes taking place in accordance with the clinical symptoms.

The chart of a moribund septic case, in which 350 cc. of adrenalin — 1–10,000 — was used, is also of interest (see Fig. 16). (Service of Dr. Elliot.)

The peritonitis and other cases after operation showed nothing remarkable. The levels ran along without marked variation at 90 to 160. Changes in the condition were noted earlier and with greater accuracy by the usual clinical observations than from the blood pressure. The moribund fall was the one change which was universally found. In no case did the blood pressure give information regarding the patient's surgical condition which was not obtainable from the pulse, respiration, temperature and general appearance.

Strychnia and atropin subcutaneously did at times, as seen in some of the foregoing charts, cause a slight change in the level of the blood pressure, but, as a rule, in sick cases no marked variation in the curve was noted.

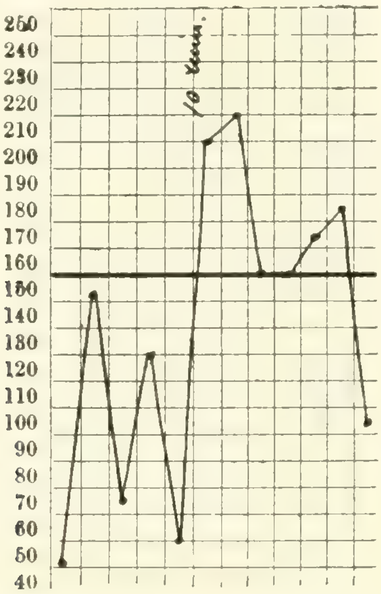

FIG. 16. — Five-minute intervals except where marked. Died thirty minutes after last reading. Pulse 150 to 160.

Salt solution in favorable cases, as in the extra-uterine before mentioned, raised the level materially, and this gain was usually held for about 25 or 30 minutes. In some instances, however, the infusion failed to check the fall, or, if there was a rise in blood pressure, it was maintained only momentarily. Where so large an amount as two pints of salt solution was given intravenously, the maximum elevation of the blood pressure was reached during the first pint.

The following chart will serve to illustrate the reaction after intravenous salt solution in favorable cases (see Fig. 17). (Service of Dr. A. T. Cabot.)

These statements are based on the results of blood-pressure observations which were made on 100 surgical cases, including 28 cases of head injury, and may be summarized as follows:

The Riva-Rocci manometer was employed in every case. A 10 cm. armlet and metal cuff was used in approximately one-half of these observations, and gave more satisfactory results than did the narrow armlet.

The blood pressure in the majority of cases confirmed the estimate of the clinical condition of the patient obtained from the pulse, temperature and other physical signs.

Deductions regarding the clinical condition drawn from the blood-pressure observations did not agree in a certain number of instances with the conclusions based upon the results of the routine clinical observations. The subsequent course of the cases proved the blood-pressure readings to have been misleading.

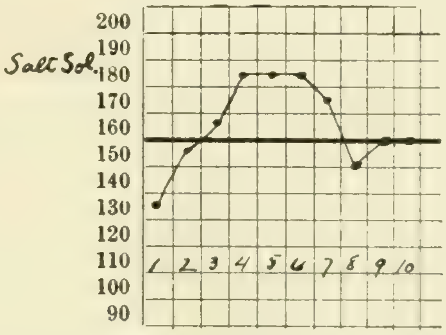

Fig. 17. — 1. Ordinary level. 2. Preparing arm. 3. One half pint. 4. One pint. 5. One and three-fourths pints. 6. Two pints. 7. Two minutes after infusion, level maintained twenty-five minutes. 8. Thirty-five minutes after infusion. 9. Forty-five minutes after infusion. 10. One hour after infusion.

The blood-pressure observations did not in any case show facts that proved to be of importance in determining the diagnosis, treatment or prognosis, which could not be obtained in the routine methods of clinical examination.

The effect of the common subcutaneous stimulants was not marked.

Normal salt solution, as a rule, raised the blood pressure, the maximum rise being reached with the administration of the first pint. The increased pressure was maintained for a variable period, usually about thirty minutes.

Cases of head injury, while not always typical and uniform in the reaction, as shown by the blood-pressure readings, seem to offer a field in which blood-pressure observations may prove to be of material assistance to the observer.

Summary of the Results of the Investigation. By the Committee on Surgical Research.

The questions which appeared to the committee to be worthy of investigation were as follows:

(1) Does the Riva-Rocci apparatus indicate the true blood pressure with sufficient accuracy for clinical purposes?

(2) In what cases and under what circumstances are the

errors due to the apparatus so great as to invalidate its advantageous use?

(3) What is the value of blood-pressure observations —

(*a*) As an indication for or against operation?

(*b*) During the course of an operation?

(*c*) In after-treatment of surgical cases?

Question (1) — Does the Riva-Rocci apparatus indicate the true blood pressure with sufficient accuracy for clinical purposes? — and *Question* (2) — In what cases and under what circumstances are the errors due to the apparatus so great as to invalidate its advantageous use? — cannot be authoritatively answered by the data in the hands of the committee. In the report from each hospital a certain number of facts appear which have a bearing upon these questions. A special series of observations was also made by Dr. F. T. Murphy with different forms of apparatus, and under normal as well as under pathological conditions. The results of these observations, which were made by Dr. Murphy at the request of the committee, are embodied in this summary. A laboratory test of the Riva-Rocci apparatus to determine the extent of its errors and imperfections was not contemplated by the committee, but rather a test of its practical value at the bedside. So far as the observations of Drs. Faulkner, Stone and Murphy go, the result of this clinical test is as follows:

It is apparent that the blood pressure is not recorded accurately under certain well-defined conditions. Arteriosclerosis and excessive development of fatty subcutaneous tissue and of muscle appear to cause an overestimate of the true blood pressure by the use of the Riva-Rocci narrow band apparatus. Repeated observations on the same normal individual, and with the same technique of application, gave practically constant readings. Variations were found with different observers under the above conditions, but with those who were accustomed to taking the pulse the error was so slight as to be negligible.

The rapid variation of the force of the heart beat in cases of dyspnea caused difficulty in the accurate estimate of the exact pressure necessary to obliterate the pulse. Maintenance of the pressure in the armlet at a point sufficient to obliterate all but an occasional pulse-wave of more than average force appeared to give the most accurate results under these conditions.

Emotional and psychic causes produced extreme fluctuations in the blood-pressure readings. In children greater variations were found to be produced by these conditions than by grave alterations in the physical condition. This observation, however, does not appear to be due to the apparatus in any way, but merely interferes with accurate deductions being made from a given observation.

Change of posture appears to alter the peripheral blood pressure to a marked degree. Four normal individuals were observed by Dr. Murphy both in the prone position and in extreme Trendelenburg position. The results were as follows:

No.	*Prone.*	*Trendelenburg.*
1	189	155
2	143	145
3	163	150
4	155	180

It will be noticed that the alteration in the blood pressure is not constant either in direction or degree. The pulse in all four cases was lowered four to six beats a minute by the change to the Trendelenburg position.

No difference was apparent between the blood pressure in the two brachials in a case of hemiplegia.

Observations were made by Dr. Murphy upon a number of normal individuals and the majority fell within the limits of 120 to 160 mm. of mercury which was given by Gumprecht,[1] as the result of a series of observations on normal individuals. Many apparently normal cases, however, gave readings beyond these limits, and estimates of the blood pressure as low as 100 and as high as 200 mm. were occasionally noted in normal individuals.

The modification of the Riva-Rocci apparatus introduced by von Recklinghausen,[2] in which an armlet of 15 cm. width is used in place of the 5 cm. armlet of the original apparatus, was adopted by Dr. Murphy, and a series of observations was made by him with this form of apparatus, which seemed to give lower and more accurate readings than with the narrow band.

A number of different widths of armlet were then obtained and comparative observations were made in a large number of cases. An armlet of 10 cm. width was found to give readings of practically the same degree as those which were wider and more cumbersome. The metal cuff, outside of the rubber armlet, as recommended by von Recklinghausen, was found to exert far less influence than the width of the armlet in every case.

An article by W. B. Stanton, *University of Pennsylvania Medical Bulletin*, 1903, Vol. xv, gives an excellent description of the comparative merits of broad and narrow armlets with the Riva-Rocci apparatus. Dr. Stanton recommends for ordinary use an armlet 3¼ inches in width, with canvas or leather cuff.

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[1] Gumprecht: Munchener Med. Woch., No. 40, 1899.

von Recklinghausen: Archiv. f. Exper. Pathol. und Pharmac., Bd. 46, p. 78.

A series of observations made with the 5 cm. and 10 cm. armlets was as follows:

	Reading with			*Reading with*	
Circumference of Arm.	*5 cm. Band.*	*10 cm. Band.*	*Circumference of Thigh.*	*5 cm. Band.*	*10 cm. Band.*
21.5 cm.	125	105	35.5 cm.	205	120
23. “	175	165	33. “	220	175
19. “	123	115	29. “	235	115
20. “	118	100	33. “	235	125
20. “	135	115	32.5 “	190	115

It is to be noted that the blood-pressure readings are, as a rule, lower with the broad armlet by from 8 to 20 mm. and that the individual variation is diminished. That the influence of the soft parts is, to a certain extent, obviated by the use of the broader armlet may be deduced from a comparison of the pressures obtained in the brachial and in the femoral arteries in this series of observations.

When a manometer has been directly connected with an artery in man, as in the instances related by Albert and by Faivre (Masing[3]), pressures of 100 to 160 mm. have been recorded. The use of the 10 cm. armlet gives results which more closely approach these actual experiments. The broad armlet, moreover, gives more definite compression of the artery, and the point at which pulsation ceases is more readily determined. For a discussion upon the physiology of this matter the reader is referred to papers by von Recklinghausen[4] and by Masing.[3] In actual clinical work these theoretical considerations appear to be justified by the results.

To sum up briefly:

(1) The inaccurate readings obtained in cases of arteriosclerosis and excessive muscular development are partially obviated by the use of a 10 cm. armlet with the Riva-Rocci apparatus.

(2) The presence of dyspnea causes inaccuracy in the blood-pressure determinations with either a broad or narrow band.

(3) Change of posture invalidates the readings obtained with either form of apparatus.

(4) Emotional individuals and children show fluctuations of the blood pressure out of all relation to the actual condition of the patient.

(5) Under other circumstances than those above recorded, the accuracy of the determinations with the Riva-Rocci apparatus appears to be sufficient for clinical purposes.

Question (3) — What is the value of blood-pressure observations (*a*) as an indication for or against operation? It is in this field that the value of the systematic determination of the blood pressure appears to the committee to be of the greatest promise. It is to be noted, however, that with the present knowledge which we have of the conditions which cause changes in the blood pressure, deductions can be made only when the conditions of the individual case are thoroughly understood. In emotional individuals and children, in cases of arteriosclerosis and of excessive muscular development and in patients suffering with dyspnea, the readings of the Riva-Rocci manometer, for reasons above recorded, are inaccurate. In injuries and diseases of the head, blood-pressure readings have promised to be of the greatest significance. The part played by the blood pressure in the symptoms of cerebral compression has been worked out by Cushing.[5] It is generally accepted that increased cerebral pressure causes an elevation of the blood pressure to overcome the anemia of the medullary centers. For this reason, increase of the blood pressure, as determined by the Riva-Rocci instrument, would, it was hoped, provide a definite indication for interference in cerebral injuries and diseases. In injuries of the head, however, the presence of shock to a greater or lesser degree must be considered, and its effects upon the blood pressure in an individual case eliminated before deductions of value can be made. It is owing to this fact especially, so far as the committee is able to judge, that the observations reported on cases of head injury have given so little general satisfaction.

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[3] Masing: Deut. Archiv. f. klin. Med., Bd. 74, Hft. 3 and 4.

[4] von Recklinghausen: Op. cit.

In cases of surgical shock the low blood-pressure observations serve, as a rule, only to confirm a diagnosis already made by the physical examination of the patient. It can be stated that a low blood pressure is to be expected in the presence of surgical shock. The actual estimate of the patient's condition and the prognosis as to life or the ability to withstand surgical interference were, as a rule, more accurately estimated by the other methods of physical examination.

In a few cases the evidence, as obtained from the blood-pressure observations, appeared even to be misleading. In hemorrhage the condition of the patient, as estimated by the pulse, respiration, temperature and general appearance, seemed to be more valuable than the blood-pressure observations. In acute abdominal conditions and in sepsis the number of observations was comparatively few, but no data of importance were obtained.

To sum up the entire matter it may be stated that graphic determination of the blood pressure by means of the Riva-Rocci instrument may be judged as an indication for or against operation only after a consideration of all of the conditions which enter into a determination of the blood pressure in the individual case. It cannot be said that a blood-pressure reading of a given degree is indicative of a given condition, but like the symptom of leucocytosis an estimate of the blood pressure may help to determine for or against operation in an individual case when taken into consideration with all of the other symptoms. The cases in which blood-pressure determinations appear to offer the greatest promise are those in which the element of shock and the element of cerebral compression are present.

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[5] Cushing: Kocher's Hirnerschutterung, etc. Nothnagel's Spec. Path. and Ther., 1901, Bd. 9, Theil 3, Abt. 2, p. 186.

Question (3) — (*b*) During the course of an operation? A change in the position of the patient is liable to cause a change in the blood-pressure reading so great as to negative its value. During the early stages of anesthesia by gas or ether, elevation of the blood pressure is to be expected. Recovery from anesthesia may also cause an elevation. The results of salt solution infusion and of subcutaneous stimulation may be determined in some cases by means of the apparatus. As a general rule, however, the condition of the patient, as judged by the ordinary physical signs, gave more satisfactory data on which to base an estimate of his physical condition than the blood-pressure reading taken by itself. The value of blood-pressure observations during the course of an operation was not apparent as a result of this series of observations.

Question (3) — (*c*) In after-treatment of surgical cases? In the after-treatment of surgical cases the number of observations made was comparatively few. The results of stimulation have been recorded above. At a period shortly before death a marked and rapid drop in the blood pressure was repeatedly observed. This drop in the blood pressure occurred with equal regularity in cases of shock, fractures of the base, general peritonitis and sepsis. This " moribund drop " made its appearance at varying intervals before death ensued, but in no case was there any doubt from the general physical condition of the patient at this time that death was imminent. When recovery ensued after operations, except for the results of stimulation above recorded, no data of value in the after-treatment of the cases were obtained.

To summarize the results of this series of observations it may be said that the value of the Riva-Rocci apparatus in determining the blood pressure in surgical patients is limited to a comparatively small number of cases. The conditions of cerebral compression and of surgical shock produce the most marked and definite alterations in the blood pressure. When these conditions are present and other confusing causes of alteration in the blood pressure are eliminated, the value of the blood-pressure determinations, as an indication for or against operation, is increased. Under other circumstances the value of these observations is at present not apparent. The adoption of blood-pressure observations in surgical patients does not at present appear to be necessary as a routine measure.[6]

[6] The experimental and clinical research entitled "Blood Pressure in Surgery," by George W. Crile (published by Lippincott, Philadelphia and London, 1903), has come into the hands of the committee only after the completion of this report. Dr. Crile has made many observations upon the blood pressure in surgical cases, and his reports are of great interest. It is to be noted that Dr. Crile found somewhat the same conflicting elements in the blood-pressure observations in individual cases which have been noted in this series of reports. In cases of head injury or operation, Dr. Crile found the element of shock to modify the expected elevation when intra-cranial pressure was increased.

The conclusions drawn by Dr. Crile are as follows: "During important operations and in the after care of certain cases, blood-pressure determinations were frequently of vital importance. . . . The blood pressure of individuals varies within a wide range: for a number of causes blood pressure in the same individual varies greatly. It is particularly difficult to eliminate the psychical factor. It is frequently difficult to interpret the blood-pressure readings when their indications are most needed. The methods of determining the pressure thus far devised are only relatively accurate. In surgical practice blood-pressure determinations have added a new resource of a fair amount of practical value. The observations during surgical operations correspond very closely with those previously published as observed in experiments on animals."

ULTIMATE RESULTS OF SOME GYNECOLOGICAL OPERATIONS AT THE MASSACHUSETTS GENERAL HOSPITAL.

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During my service as surgical house officer at the Massachusetts General Hospital I had occasion to hear several adverse criticisms from some members of the medical staff in regard to the results of gynecological operations which had been performed there. These criticisms were inspired by the patients who returned to the out-patient department for treatment after operation. With the idea of reaching some definite conclusion on the subject, I have, during the past year and a half, obtained the after-history of many of the cases who had undergone operations of this class during the past five years and have had an opportunity of examining a limited number of them. Each member of the surgical staff gave me permission to use his cases, so that I have had all the cases in the three surgical services at my disposal.

The conditions included in this investigation are limited to lacerations of the cervix and vaginal outlet, displacements of the uterus, endometritis and uterine fibroids. A few cases of cancer of the uterus were also traced, but only those on whom radical operation was performed, those not having been followed which were in too advanced a stage to allow of anything but palliative treatment. Under the other heads, every case was written to which had been discharged from the hospital in good condition. In all, about 450 letters have been sent out, the patients being asked briefly to describe any trouble they may have had since the operation. About 250 responded, but in several cases the answer was too vague to give any idea as to the real condition. All the patients previously written to were asked to come to the hospital on some day during a period of ten days last summer. Ninety-five patients came and most of them were examined. The examination was unsatisfactory and valueless in many of the cases who had had lacerations repaired, owing to their having been confined since operation, but in most of the other cases a very satisfactory idea of the anatomical as well as the symptomatic result was obtained.

Thus altogether there are 58 cases in whom both the anatomical and symptomatic results have been recorded and 159 in whom only the symptomatic result has been obtained. In these cases the data have been obtained from the patient's written statement and although a more accurate and perhaps a more favorable idea of the result would have been obtained from a personal interview, it must be granted that an operation has failed in its purpose if it has not, in the opinion of the patient, relieved the symptoms for the relief of which it was performed, even if the anatomical result be perfect.

There are 53 cases in whom lacerations of the perineum or cervix or both were repaired. Twenty-three of these have been examined, but in 10, confinement had occurred since operation, so that the examination could not give an accurate idea of the result of the operation. These 10 cases will be spoken of among the others in whom only the symptomatic result was obtained.

Of the 13 cases in whom confinement has not occurred since operation, 6 have had satisfactory anatomical results, 5 have had only partially satisfactory results and 2 have had bad results.

Of the 6 cases who have had good anatomical results, 5 have been relieved of symptoms, while 1, in whom the perineum only was repaired but in whom there was also retroversion, has been somewhat helped but still has very annoying backache.

Of the 5 cases in whom I have classed the anatomical result as being only partially satisfactory, the cervix only was repaired in one and the cervix and perineum in the other 4. Of these 4 cases, 1 has been entirely relieved of symptoms, 1 has been partially relieved, while 2 have had no relief whatever. In one of these 2 last-mentioned cases there was endometritis and retroversion and the uterus was curetted a week before the lacerations were repaired. The uterus is now retroverted and there is a very incomplete perineum. The patient complains of dysmenorrhea and constipation and says the uterus comes down every evening. She considers herself no better than before operation. In the other case, the uterus was also curetted. There is a good cervix, but the perineum is poor. The uterus is in normal position. The patient complains of pain in the back and right side of the pelvis, which she says is just as bad as before operation.

The case in whom the cervix only was repaired says that before operation she never had any trouble with her catamenia. Since then, however, she has had a feeling of pressure in the head, often accompanied by nausea and palpitation for three or four days before the period. These symptoms pass off with the appearance of the flow. The uterus is enlarged and tender and there is much erosion of the cervix, which, however, is intact. I have classified this case as partially satisfactory anatomically, because although the laceration of the cervix has been successfully repaired it seems probable from the symptoms that the cervical canal was too tightly closed.

In the 2 cases of bad result, both cervix and perineum were repaired. One of these was seen two years after operation. The perineum was torn to the sphincter and the cervix was occupied by a hard nodular growth, the size of an English walnut, suggesting fibroid. In the other the operation was entirely unsuccessful and the lacerations were again repaired last April, at the City Hospital, five years after the first operation. Neither patient received any relief of symptoms.

Thus in the 6 cases of good anatomical result, 5 have been cured of symptoms, while 1 has been partially relieved. Of the 5 cases of partial anatomical success, 1 has been cured, 1 has been partially relieved and 3 have had no relief. Of the 2 cases of anatomical failure, neither has received any relief of symptoms.

Beside these 13 cases, there are 40 cases in whom the cervix or perineum or both were repaired, and who have been heard from by letter. Combining these two groups, there are 53 cases in whom the symptomatic result is known. Fourteen or 26.4% have been entirely relieved, 25 or 47.2% have been partially relieved and 14 or 26.4% have had no relief.

Of these last 14 cases, 5 have been examined and have already been spoken of. Of the remaining 9 cases, in 1 a recto-vaginal fistula resulted from the operation and the discomfort from this has overshadowed any benefit which might otherwise have been felt. In another case there was superficial sepsis in the perineum during convalescence. This patient says she has been under a doctor's care ever since and is not at all satisfied with the result of the operation. The other 7 cases simply state that they have been no better since operation and a few say they are not so well as before.

There are 5 cases in whom cystocele was operated on besides other lacerations. Four of these have been heard from by letter. Two have had entire relief of symptoms and 2 have received no benefit. The fifth case, in whom a rectocele was also repaired, was seen three years after operation. There was a well-marked cystocele but the rectocele had been entirely cured. The patient had been perfectly well for a year and a half after operation, but had then caught a severe cold, immediately following which the symptoms which were present before operation, bearing-down pain and discomfort in walking, returned and have continued ever since, so that she now considers herself no better than before operation. In spite of the temporary relief in this case, the ultimate result cannot be said to be satisfactory, so that in these 5 cases of cystocele, the result has been satisfactory in only 2 or 40%.

There are 22 cases in whom endometritis was present and in whom only dilatation and curettage was done. In 17 of these endometritis was the only abnormality, while in the 5 remaining cases other lesions were also present.

Of the 17 cases of uncomplicated endometritis, 9 (53%) have had complete relief of symptoms. In 4 (23.5%) there has been partial or temporary relief, while the remaining 4 (23.5%) have received no relief.

Of the 4 cases which I have placed under the head of partial relief, the first, on whom the operation was performed for the relief of leucorrhea, menorrhagia and dysmenorrhea, the dysmenorrhea has not been relieved, but the leucorrhea is very much better and the periods are now normal in quantity. The second case, who was fifty-three years old at the time of operation, complained of menorrhagia. There was, besides endometritis, prolapse of the uterus, cystocele and lacerated perineum. She has had no catamenia since the operation but has occasional "unpleasant discharges." She wears a pessary and considers herself no better than before operation. The third case, forty-four years old, had hyperplastic endometritis. She says she was helped for a few months but that since then she has been only slightly better than before operation. The fourth case, twenty years old and unmarried, had endometritis. She says she was helped for a short time after operation but is poorly now, suffering from light-headedness and fainting sensation and constant leucorrhea.

Of the 4 cases who have had no relief, in 1 the pathological report on the uterine mucosa was glandular hyperplasia. She says she had a severe hemorrhage on the way home and has had a slight but constant bloody flow ever since. She now considers herself worse than before operation. The second case was operated upon for backache, irregular catamenia and constant leucorrhea. Over a year after the operation she was in the same condition as before. The third case, who had uncomplicated endometritis, wrote nearly two years after operation that she had been no better. The fourth case complained of backache, headache and painful micturition. A caruncle of the urethra was cauterized after the uterus had been curetted. Three and a half years later she reported by letter that there was no relief of symptoms, and five years after operation she was seen personally by the writer. She still complained of the symptoms for which she had been operated on. Examination revealed nothing, owing to the patient's extreme nervousness and sensitiveness. No trace of a caruncle, however, could be found.

Of the 5 cases in whom endometritis was not the only abnormality, retroversion was present in all, and in 1 there was also a lacerated cervix. One of these says she has had perfect health since operation, 3 have been helped but not entirely relieved and 1 says she is no better than before operation.

Of the 4 cases who have not had entire relief 1 was interviewed four years after operation. She says she has had 4 miscarriages since the operation, but in spite of that feels better than before she came to the hospital. The uterus is in retroversion but there is no endometritis. The second case, thirty-six years old, was thought to be in very early pregnancy at the time of operation. She says she did not regain her strength after leaving the hospital and was curetted again at Lynn one and a half years later on account of a miscarriage. Since then her health has been very good. When seen last summer, she had been having leucorrhea for three months. The uterus was retroverted and there was marked endometritis. The third case was operated on when forty years old. Five years later, when seen, she said she had been fairly well since the operation but not very strong. One week before I saw her she had had an abortion performed. The uterus was large and soft but in good position and there were extensive lacerations. The fourth case, who was operated on three years ago and who had had no relief of symptoms, presented when seen last summer a well-marked splanchnoptosis. The uterus, which was retroverted at the time of operation, is now in good position, but the kidneys and liver descend abnormally on inspiration and in the upright position, both kidneys descend to the crests of the ilia and the lower border of the liver is just below the umbilicus, the stomach also descending to well below the umbilicus. No mention of this condition was made in the records but it is probable that it was present at the time of operation and is amply sufficient to account for the lack of relief obtained by curetting the uterus. She has been fitted with an abdominal supporter, but I have not been able to find out whether or not it has given any relief.

Thus of these 22 cases in whom curettage for endometritis was done, 10 have been cured, 7 have been partially relieved and 5 have received no benefit.

There are 62 cases of retroversion. Forty-six of these were treated by ventral fixation alone, 6 were treated by ventral fixation and repair of lacerations, 4 were treated by curettage only and 6 by Alexander's operation.

Twenty-two of the 46 cases treated by ventral fixation alone have been examined. Of these 22 cases, 17 have had excellent anatomical results, 1 has had a partially successful result and in 4 the retroversion has recurred. Of the 17 cases who have had excellent anatomical results, only 4 have been entirely relieved of symptoms, while 10 have been partially relieved and 3 have had no relief. The one case in whom the anatomical result has been partially successful has had partial relief of symptoms. Of the 4 cases in whom the operation was anatomically unsuccessful, 3 have had no relief of symptoms, while 1 says she has been perfectly well since operation. Thus of 17 cases in whom retroversion has been successfully corrected, only 23.5% have been cured.

Of the 10 cases of excellent anatomical result who have been placed under the head of partial symptomatic relief, the first case, thirty-seven years old, in whom the uterus was in retroversion and adherent to the rectum and the omentum adherent to the left ovary, was seen one year after operation. She complained of weakness after the day's work, with some backache and severe headache during the catamenia. She thought she had had a miscarriage at three months six months after operation. The uterus was in good position though perhaps rather far forward, and the cicatrix was firm. The second case, thirty-four years old, was seen three and a half years after operation. She still had a dragging backache which, however, was less than before operation. She also complained of pain in the right side after standing, which was relieved on lying down. She said she could do very little. Examination showed the uterus in good position but there was well-marked rectocele and cystocele. The third case, fifty-three years old, says her general health is improved but she still has more or less backache and occasional twinges of pain in the left side. Local treatment at the Massachusetts General Hospital a year ago gave her no relief. The catamenia had ceased six months before operation. The uterus is in good position and nothing was found to account for the symptoms. The fourth case, twenty years old and unmarried, says she is better than before operation but still complains of backache and a steady pain in the front of the abdomen. Dysmenorrhea is less severe than before operation but she has leucorrhea for a few days before the periods. The uterus is in normal position but there is a slight thickening of the left tube, which may account for the symptoms. The fifth case, twenty-eight years old and married, had had the left ovary removed six years before the uterus was suspended. She is much better than before operation but still has more or less pain in the right side. The uterus is in normal position. She is reported by her physician to be moderately hysterical and introspective, a type of patient in whom complete cure is hardly to be hoped for. The sixth case says she was well for six months, when after hard work she had steady abdominal pain for one week and since then has had the same pain occasionally. She now complains of getting tired very easily. The uterus is in good position but there is a slight cystocele. In the seventh case, thirty-nine and married, tucks had previously been taken in the round ligament without correcting the retroversion. One year later the uterus was suspended and a ventral hernia resulting from the former operation repaired. The hernia recurred in six weeks and nine months later it was again repaired, the uterus being found suspended by a fibrous cord about three inches long. The hernia had not recurred when I saw her two and a half years after the last operation and the uterus was in good position. She said she was perfectly well except for a burning sensation in the wound after working. In the eighth case, twenty-seven years old and married, a cystic ovary was removed at the time the uterus was suspended. She has been much better since operation but still has some backache. The uterus is in good position but there is a hard insensitive mass the size of an egg low down on the right side of the uterus which seems like a fibroid and which is presumably the cause of the persistence of the backache. The ninth case, thirty-three years old, complained chiefly of dysmenorrhea before operation. This has not been at all relieved but she says she has less backache between the periods than before. The uterus is in good position but there is a fibroid the size of an English walnut on the posterior surface of the uterus and slight thickening and tenderness of the left tube. The tenth case, fifty-five years old, wrote three years after operation that she felt much better for the operation but still had to wear a support. Examination one year later showed the uterus to be in excellent position.

Of the 3 cases who have had successful anatomical results but who have received no relief of symptoms, the first, thirty-four years old and unmarried, was operated on three and a half years ago. She says she has never been as strong since, as before, the operation. The catamenia is regular but scant and as painful as before, and she feels that she has not been helped. The second case, thirty years old and married, says that the backache, leucorrhea, painful micturition and frequent headaches, of which she complained before operation, have not been relieved at all. The third case, thirty-three years old and married, complained of constant pain in the left side and leucorrhea. The uterus was retroflexed and adherent. The pain has been just as bad since operation. Five months ago she bore twins, and she is now very nervous and tired. There is a deep stellate laceration of the cervix and the perineum is badly torn but the uterus is in good position.

The one case who has been classed as showing a partially successful anatomical result was sixty-two years old and married. She is much better than before operation but still complains of backache, frequent micturition and of feeling something come down after hard work. There is a well-developed cystocele and some prolapse of the uterus, which is, however, suspended to the anterior abdominal wall.

Of the 4 cases in whom the retroversion has returned, the first, forty-one years old, says she has been perfectly well except for occasional attacks of pain and swelling in the left leg in which there was phlebitis during convalescence. The uterus is retroverted and slightly enlarged but freely movable. The second case received no relief of symptoms and was told at the hospital, six months after the operation, that she ought to have the operation repeated. The uterus is retroverted. The third case, twenty-two years old and unmarried, had an anteflexed and retroverted uterus. The uterus was straightened with a probe and curetted, and a week later was suspended to the anterior abdominal wall. She had had no relief either of dysmenorrhea or of backache. The uterus is now in the same condition as before operation. The fourth case, twenty-seven years old and unmarried, complained chiefly of dysmenorrhea before operation. There has been no relief of symptoms and she now finds partial relief by wearing a pessary.

There remain 24 cases of retroversion in whom ventral fixation only was done and in whom only the symptomatic result has been obtained. Thirteen or 54.16% of these have been entirely relieved of symptoms, 2 or 8.33% have been partially relieved and 9 or 37.5% have received no benefit.

This result is in striking contrast to that among the cases who returned to the hospital for examination, for of the 21 cases in this latter category, only 23.8% have been cured of symptoms, while in the 24 cases whose subsequent history has been obtained by letter, 54.16% say they have been entirely relieved of symptoms. This discrepancy can probably be accounted for by the assumption that, as a rule, those cases who have been cured did not care to take the trouble to come to the hospital, while those who have not been entirely relieved came in the hope of receiving some further benefit.

If the statements of those who were seen and questioned and the written statements of those who replied by letter be given equal weight, it is found that in this series of 46 cases of ventral fixation for retroversion, 18 or 39.14% have been cured, 13 or 28.26% have been partially relieved and 15 or 32.6% have received no benefit.

Of the 6 cases in whom lacerations were repaired and the uterus suspended, 3 have been entirely relieved of symptoms, 2 have been partially relieved and 1 says she has had very little relief.

Only one of these cases was examined. She is forty-eight years old. The uterus was suspended and the perineum repaired. She still has some backache but feels much better than before operation. The uterus is in good position but somewhat enlarged and there is a deep bilateral laceration of the cervix. There is a good perineum. The laceration of the cervix in this case is probably the cause of her symptoms.

Four cases were treated by curettage. One of these has been perfectly well, 2 have been partially relieved and 1 has received no relief.

Of the 3 cases who have not been cured, in the first, twenty-three years old and unmarried, adhesions of the uterus were stretched while under ether. She has been partially relieved of the dysmenorrhea for which the operation was performed. In the second case, a fistula in ano was curetted at the same time. She writes that the fistula has been cured but that she has had more or less womb trouble ever since. A second letter asking for more details has not been answered. The third case died of pneumonia six months after operation. The husband writes that she did not seem to have been helped by the operation.

Of the 6 cases who were treated by Alexander's operation, only one was examined. In this case the chief symptom before operation was menorrhagia. This became worse after operation and the uterus was curetted at the hospital six months later, the uterus then being recorded as in retroversion. Since then she has grown stronger, but when I saw her four years later she said the pain was just as bad as before and that she had had pain in the left side ever since the operation. The uterus was anterior but enlarged and pulled to the right side of the pelvis and there was some tenderness on the left side.

Two cases returned to the hospital, sixteen months and two and a half years later, respectively, with return of the retroversion. Both had ventral fixation performed with an excellent result in both. The third case writes that she felt a little better for a year after operation but that since then she has had more pain than before.

The fourth case says the operation was successful except that she cannot carry a child more than five months, she having had two miscarriages since operation. The fifth case says she has been troubled with soreness in the right side since operation, and has severe pain unless she wears a support. She probably has a hernia.

Thus symptomatic results in these 6 cases have been good in only 1 and very unsatisfactory in 5. In the one case which was examined, the original malposition of the uterus has only been changed to another form.

Seven cases of prolapse of the uterus have been traced.

Three of these were treated by ventral fixation and repair of lacerations. Of these 3 cases, 2 have been examined. One of these had a perfect anatomical result and had been perfectly well for over two years since the operation. The other was seen three years after operation, at which a cystocele and rectocele were repaired and the uterus suspended. There is a fairly firm perineum, but the cystocele has recurred and the cervix protrudes from the vagina, so that the patient has to wear a napkin. In spite of this, however, she considers herself very well except for some dragging pain on micturition. The other case in whom the perineum was repaired and the uterus suspended was heard from two years after operation by letter, in which she stated that she was very little better than before operation.

In the other 4 cases, lacerations were repaired, the uterus not being suspended. Three have been examined and in all of them the prolapse had recurred, 1 has felt somewhat better since the operation, while the other 2 have received no relief. The other case, who was heard from by letter, says she is in very good health and has trouble with the uterus only when lifting heavy weights. Thus in 3 cases of prolapse of the uterus, repair of lacerations and suspension of the uterus has been entirely successful in 1, and has given only slight relief in 2, while in 4 cases repair of laceration without suspension has given nearly complete relief in 1, slight relief in 1 and has entirely failed in 2.

There are 18 cases of procedentia. Nine of these were treated by ventral fixation and repair of lacerations. Of these 9 cases, 4 were examined and in all but one the procedentia had returned soon after operation. In this one case the uterus was suspended and the perineum and a cystocele were repaired. The uterus is now adherent to the abdominal wall, but the cervix is just within the vaginal outlet and there is a large cystocele. The patient has not been relieved of symptoms, still complaining of pain and a dragging sensation in the pelvis.

The other 5 cases have been heard from by letter. One says she has "got along wonderfully well," which probably means that the uterus has been restored to its normal position; 3 say that they are better than before operation, but still feel as though the uterus might descend if they are not very careful; and in the fifth case the trouble became as bad as ever a few weeks after operation.

Thus in 9 cases of procedentia treated by ventral fixation and repair of laceration, there has been entire symptomatic relief in only 1, and partial relief in 3, while of the remaining 5 cases there has been no relief, the procedentia having recurred in 4 of them.

Four cases were treated by ventral fixation alone. None of these have been examined. Three say they are just as bad as before operation, while one has been perfectly well and had a successful confinement two years after operation.

Two cases were treated by Alexander's operation and repair of the vagina. In both the procedentia has recurred and neither has been helped in any way. One has a double inguinal hernia, doubtless as a result of the operation.

In one case the perineum only was repaired. This case wrote over two years after operation that she was somewhat better but had to insert a sponge to keep the uterus from protruding when on her feet.

In two cases vaginal hysterectomy was performed and the vaginal outlet repaired. One wrote four years later that she then had the same trouble as before, while the other, three years after operation wrote that the "cushion of the bladder" came down somewhat and that she also had leucorrhea but that otherwise she felt very well.

In summing up the results in these 18 cases of procedentia, it is found that of 9 cases treated by ventral fixation and repair of lacerations, only 1 has been cured, 4 have been relieved to some extent and in 4 the procedentia has recurred. Of 4 cases of ventral fixation alone, 1 has been entirely relieved, while in 3 the condition has recurred. Repair of the perineum in 1 case has given only partial relief, and Alexander's operation has given no relief whatever in 2 cases. Vaginal hysterectomy with repair of the vaginal outlet has given no relief in 1 case and partial relief in the other. Thus in these 18 cases of procedentia only 2 (11.1%) have been cured, 6 (33.3%) have been partially relieved and 10 (55.6%) have been in no way benefited by the operation.

Fifty cases of uterine fibroid have been followed. In 42 of these supravaginal hysterectomy was performed, in 5 myomectomy and 3 were discharged without operation.

Twelve of the cases of hysterectomy were examined. Eight of these have had perfect anatomical results and all but one say they have been perfectly well. This one case was perfectly well and strong for three years after operation except for mild symptoms of the menopause, but for the last two years she has had pain in the right side of the pelvis, which was the location of the pain before operation. Examination showed nothing to account for it.

Of the other 4 cases who were examined, 2 have endometritis and vaginitis, which according to their statements has been present since operation. Of the other 2 cases, 1 has a hernia in the scar and there is a hard tumor, which feels like a fibroid, about the size of an English walnut, in the left side of the pelvis. She feels, however, perfectly well, complaining only of occasional headache. In the other, there is a smooth, rounded bony tumor on the inner surface of the pubes on the left side which is entirely insensitive to touch but is the seat of occasional sharp twinges of pain. A fibrous band extends from the tumor to the cervix, which is, however, perfectly free except for this. The patient says she first felt the tumor six months after operation and that it has been slowly growing during the four and a half years which have elapsed since then. She feels otherwise perfectly well.

In discussing the symptomatic results of these cases of hysterectomy for fibroid, I shall leave out of consideration the symptoms arising from artificial menopause, as these will be considered separately.

Of the 42 cases of this series, including those which have been examined, 33 (77.5%) have been perfectly well since operation and the other 9 cases have had more or less trouble. Five of these 9 cases have been described in speaking of the anatomical results. Of the other 4 cases, 1 had a hernia in the scar and vaginal inflammation and piles which had not been helped by local treatment at her home. Last April the hernia was repaired and the hemorrhoids cauterized at the Massachusetts General Hospital, with what result I have been unable to ascertain. The remaining 3 cases have complained of general weakness and nervousness but have had no local symptoms referable to the operation. In view of the fact that both ovaries were removed in these 3 cases, it is probable that the nervous symptoms are due to the menopause, and that they are, therefore, only temporary. Hence the results may be considered satisfactory. Thus the total of cases in whom the result has been satisfactory is swelled to 36 or 85.7%.

In regard to the effect of leaving one or both ovaries in a hysterectomy for fibroid, in avoiding the symptoms of the artificial menopause, data have been obtained in only 28 cases, because many patients have not given any information as to nervous symptoms following operation and have not answered later letters containing specific questions and because in the records of 7 cases I can find no clew to show what was done with the ovaries.

Of these 28 cases, in 23 both ovaries were removed. Twenty-one of these 23 cases have had moderate or slight symptoms, such as flushing, giddiness, chills or palpitation. In the other 2 cases there have been no symptoms. One of these was fifty-four years old and had flowed only once in the six months before operation, so that it is probable that the climacteric was well established when the ovaries were removed. The other case was thirty-seven years old. There was a large fibroid extending to above the umbilicus. Her periods had been regular.and normal up to three months before operation. She skipped the next period and since the last one, which came at its regular time, she had been flowing constantly. She writes, three years after operation, that she has been perfectly well and has had no nervous symptoms whatever. It would seem probable from this that the irregularity in the catamenia before operation was due to the menopause rather than to the presence of the fibroid.

Of the 5 cases in whom one or both ovaries were left, 3 have had typical symptoms of the climacteric. These cases were forty-two, forty-three and forty-six years old. All three had had menstrual irregularity before operation, and this in conjunction with their ages leaves little doubt that the menopause was beginning at the time the ovaries were removed. Whether or not the nervous symptoms were less severe than they would have been if both ovaries had been removed cannot, of course, be known. The fourth case was forty years old, and the catamenia was normal up to the time of operation. One ovary was left. She writes that she has had no typical symptoms of the menopause but has had chills accompanied by malaise and headache every month for three years. There has been no flow, but she has associated these symptoms with the catamenia on account of their regularity. She says she has not been so strong or "ambitious" since the operation. It is hard to see how any good has been done in this case by leaving an ovary. The fifth case, forty-five years old at operation, had flowed for ten days every two weeks for the previous ten years. There was a fibroid the size of a large egg and supravaginal hysterectomy was done, both ovaries being left. She writes, three years after operation, that she has been perfectly well and has flowed regularly, though much less profusely, ever since. She has had no nervous symptoms whatever. This, then, is the only case in which distinct good has been attained by avoiding castration, and the result is the more interesting as the patient was at the age when the menopause was to be expected.

These statistics, although too few to afford ground for any comprehensive conclusion, are reported because they seem to show pretty definitely, in spite of the exception just described, that in patients over forty years of age little benefit is to be derived from leaving an ovary and also because they show that sometimes in cases considerably younger than the usual age at which the menopause is to be expected, no symptoms follow complete castration.

Of the 5 cases of fibroid on whom myomectomy was done, 4 have been perfectly well during periods varying from two to six years after operation. The fifth case writes that she has not been in good health and suffers from backache. She says that her doctor thinks there may be another tumor growing.

Of the 3 cases who were not operated on, one, aged thirty-nine, had a fibroid the size of a cocoanut. It was not removed on account of the absence of symptoms and the history of Graves' disease. She wrote about four years after leaving the hospital that she felt poorly for eight months after leaving the hospital but that since then she has been in good health. She thinks the tumor is growing very slowly. It would be of interest to know whether the menopause has occurred, as this might account for the improvement in her condition, but she makes no mention of her catamenia and a second letter has not been answered.

The second case, forty-three years old, had a large fibroid. Hysterectomy was advised but refused. Three years later the patient reported that she felt much better. Up to a year before she had had a constant bloody vaginal discharge, but since then, the periods have been regular and the flow profuse but lasting only five days. There is now a constant watery discharge but without blood. There are no symptoms except occasional pain in the region of the left ovary. The fibroid now extends nearly to the umbilicus. It is freely movable and without tenderness. The patient says she does not think it has increased in size during the last three years.

The third case is now fifty-three years old. She was at the hospital four years ago with a large fibroid, twice the size of a child's head and adherent behind and laterally. The patient declined operation on account of the lack of symptoms. When seen last summer she said she had had no trouble since she left the hospital. Menstruation had ceased over two years ago and she had had no vaginal discharge since then until the last month, when she had noticed slight leucorrhea. There was a large fibroid reaching nearly to the umbilicus which seemed to be adherent. She said she had been enjoying better health since the menstruation ceased than for the last twenty years. Evidently, in this case, the improvement in the general condition has been due to the menopause.

Thus in none of these 3 cases has any ill effect resulted from not having removed the fibroid. They were all near the age of the menopause, and we know this has occurred in one case. In the other two it is probably about to occur.

Twelve cases of cancer of the cervix or body of the uterus on whom radical operation was performed and who left the hospital in good condition have been traced. Five of these cases have been examined, 4 have been perfectly well and show no sign of recurrence two and a half, four and a half, five and five and a half years after operation, respectively. The fifth case, three and a half years after operation, shows a slight indefinite thickening on the left side of the pelvis, entirely free from the vault of the vagina, which shows a perfectly normal scar. There are no symptoms whatever. It is impossible to say whether this thickening is recurrence or not.

In 5 cases, recurrence and death occurred within three years. Of the other 2 cases, 1, operated on a little over two years ago, is perfectly well and has no pain nor vaginal discharge. The other, five years after operation, said she was perfectly well and had no vaginal discharge until two months before I saw her, when she had had a slight show after lifting a heavy weight. She refused examination, without which it is of course impossible to know whether or not this slight flowing was due to beginning recurrence.

Thus of 12 cases of radical operation for cancer, in 5 recurrence and death occurred within three years and in 3 cases there was no sign of recurrence four and a half years or more after operation. Of the other 4 cases, the time since operation is too short to give any idea as to the probable outcome in 2 and the evidence is inconclusive in the other 2. It may, therefore, be said that cure has been obtained in 3 cases, that the operation has failed in 5 and that the result is still uncertain in 4.

In summing up the results of this investigation, the following conclusions have been reached:

The anatomical results of repair of lacerations of the cervix or perineum, or both, in 13 cases have been satisfactory in 46%, partially satisfactory in 38.5% and entirely unsatisfactory in 15.5%. The symptomatic result in 53 cases has been entirely satisfactory in 26.4% and partially satisfactory in 47.2%, leaving 26.4% in whom there has been no relief. Of 5 cases in whom cystocele was repaired, there has been a satisfactory symptomatic result in only 2 or 40%.

Curettage for endometritis in 22 cases has given complete symptomatic relief in 45.5% and partial relief in 31.8%, the remaining 22.7% having received no benefit.

Ventral fixation for retroversion in 22 cases has been ana-

Lesion.	Operation.	Anatomical Result.							Symptomatic Result.							
		Excellent.	Percentage.	Fair.	Percentage.	Poor.	Percentage.	Total.	Excellent.	Percentage.	Fair.	Percentage.	Poor.	Percentage.	Total.	Total of Lesion.
Lacerations	Repair of Cervix or Perineum or both	6	46	5	38.5	2	15.5	13	14	26.4	25	47.2	14	26.4	53	58
	Repair of Cystocele and Perineum			1	100			1	2	40	1	20	2	40	5	
Endometritis	Curettage								10	45.5	7	31.8	5	22.7	22	22
Retroversion	Ventral Fixation	17	77.3	1	4.6	4	18.1	22	18	39.1	13	28.3	15	32.6	46	62
	Ventral Fixation and repair of lacerations	1	100					1	3	50	2	33	1	17	6	
	Curettage								1	25	2	50	1	25	4	
	Alexander's operation			1	33.3	2	66.6	3	1	16			5	84	6	
Prolapse	Ventral fixation and repair of lacerations	1	50			1	50	2	1	33.3	1	33.3	1	33.3	3	7
	Repair of lacerations					2	100	2	1	25	1	25	2	50	4	
Procedentia	Ventral fixation and repair of lacerations			1	25	3	75	4	1	11.2	4	44.4	4	44.4	9	18
	Ventral Fixation								1	25			3	75	4	
	Repair of Perineum										1	100			1	
	Alexander's operation												2	100	2	
	Hysterectomy and repair of lacerations										1	50	1	50	2	
Fibroid	Hysterectomy	8	66.6	4	33.3			12	33	77.5	9	22.5			42	50
	Myomectomy								4	80	1	20			5	
	Not operated								3						3	
Cancer	**Pan-hysterectomy**	**No recurrence 4½ years or more after operation 3**				**Recurrence and death 5**		**Uncertain 4**								

tomically successful in 77.3%, partially successful in 4.6%, and has failed to cure the displacement in 18.1%. In spite of this satisfactory percentage of anatomical cure, only 23.5% of these 22 cases have received satisfactory symptomatic relief.

The symptomatic results in 46 cases of ventral fixation, including the above, have been entirely satisfactory in 39.1%, partially satisfactory in 28.3% and unsatisfactory in 32.6%.

Of 6 cases of ventral fixation with repair of lacerations, 50% have been cured, 33% have received partial relief and 17% have not been helped.

Of 6 cases of Alexander's operation only 16% have been cured, while the remaining 84% have received no benefit.

Of 4 cases treated by curettage alone, 25% have been cured, 50% have been partially relieved and 25% have not been helped.

Taking all these cases together we find that in 63 cases of retroversion, the symptomatic relief has been complete in 37% and partial in 27.5%, while in 35.5% there has been no relief.

Of 7 cases of prolapse, in 3 ventral fixation and repair of laceration was done, giving entire symptomatic relief in 1, partial relief in 1 and no relief in 1, while in 4 cases repair of lacerations without ventral fixation has given complete relief in 1, partial relief in 1 and no relief in 2, a total of entire relief in 28.6%, partial relief in 28.6% and no relief in 42.8%.

Of 18 cases of procedentia, in 9 ventral fixation and repair of lacerations have given entire symptomatic relief in 11.2%, partial relief in 44.4% and no relief in 44.4%. In 4 cases ventral fixation alone has given entire symptomatic relief in 25% and no relief in 75%. Alexander's operation has failed to give any relief in 2 cases; hysterectomy with repair of lacerations has given partial relief in 1 case and no relief in 1 case, and repair of the perineum has given partial relief in 1 case. Taking these 18 cases together, 11.1% have been entirely relieved, 33.3% have been partially relieved, while 55.6% have received no benefit.

Of 42 cases of hysterectomy for fibroid, 77.5% have been entirely relieved, while the remaining 22.5% have been only partially relieved. In 3 of the cases of partial relief, the trouble since operation has been slight and probably wholly dependent on the artificial menopause — so they may be classed as satisfactory. Thus 85.7% of these 42 cases have shown satisfactory symptomatic results.

The anatomical results in 12 cases of hysterectomy have been perfect in 66.6%, while the remaining 33.3% show no serious defect.

In regard to the avoidance of the symptoms of the artificial menopause by leaving an ovary in hysterectomy for fibroid, these cases show that little benefit is to be expected in cases over forty years old.

Of 5 cases of myomectomy, 80% show entire symptomatic relief, while in the remaining 20% there has been partial relief.

Three cases of fibroid, discharged without operation, have all been perfectly well for over three years.

Of 12 cases of cancer of the uterus on whom radical operation was performed, 3 show no sign of recurrence four and a half years or more after operation and may, therefore, be considered as probably cured. In 5 cases recurrence and death occurred within three years, while in the remaining 4 cases the result is still doubtful.